ANNUAL REPORT

FOREST PEST CONDITIONS IN WISCONSIN

1970

WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FORESTRY, WILDLIFE
AND RECREATION
BUREAU OF FOREST MANAGEMENT

FOREST PEST SURVEY AND CONTROL

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PREFACE

This report is a compilation of information received from a variety of sources. It is based largely on seasonal reports from field pest survey and control personnel and their annual reports. These are supplemented by information on forest pest conditions received from cooperating field personnel in our own and other agencies.

"Thank you" to all who have contributed in any way to the content of this 1970 report.

Donald W. Renlund, Chief
Forest Pest Survey and Control Section

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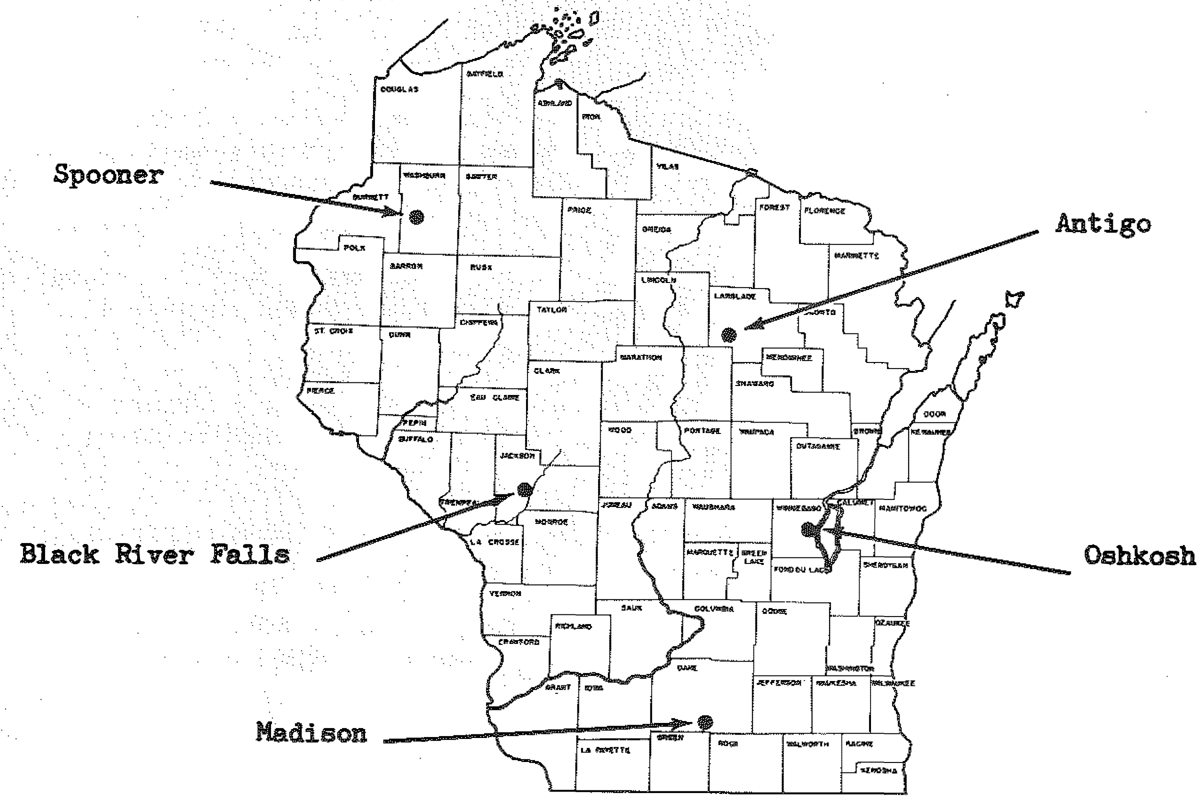


Highlights of Forest Pest Conditions

-- Jack-pine budworm populations increased in many stands in the northwest counties, but decreased in the northeast and west central counties.

-- A spruce budworm outbreak, the first extensive one in Wisconsin in recent years, resulted in moderate to severe defoliation of 6,500 acres of spruce and balsam in Oneida County.

-- Anticipated pine tussock moth populations failed to materialize in Douglas County, but a new outbreak in jack pine along the Burnett-Polk County line caused varying degrees of defoliation and tree mortality on a 2,000 acre area.

-- Pink-striped oakworm continued defoliating oak in Douglas County for the third successive season, but the population dropped considerably.

-- Introduced pine sawfly caused severe defoliation of white pines in Barron, Burnett and Polk Counties. Although reported from most central counties, little severe defoliation was encountered except in parts of Waupaca County.

-- Pine root weevils of the genus *Hylobius* continued to cause the greatest losses in timber and Christmas trees in central Wisconsin.

-- The variable oak leaf caterpillar, *Heterocampa manteo* (Doubleday), made its presence known for the first time by causing severe defoliation in several widely scattered locations in west central Wisconsin.

-- Oak skeletonizer was widespread over the state. The identity of the skeletonizer(s) involved, presumed until now to be *Bucculatrix ainsliella* Murtfeldt, is being checked.

-- Following three successive years of timber defoliation on Rock Island by the saddled prominent caterpillar, ground vegetation was extremely dense and luxuriant, wild fruit production, especially strawberries, was prolific and spring flowers were abundant.

-- A number of pests were active on aspen in the north central counties including the aspen leaf tier, large aspen tortrix, aspen blotch miner and a chrysomelid beetle.

-- Dutch elm disease continued its spread along streams and other lowlands in Menominee County. Infected trees were also commonly observed along the Black River Valley.

-- Brown spot needle blight was a major problem for growers of Scotch pine Christmas trees in the central counties.

-- The effects of extended drought on a variety of trees and shrubs, were observed in many forest areas over the state. This was the second dry summer in some localities.

MAJOR FOREST INSECTS

COLEOPTERA

Bronze Birch Borer - Agrilus anxius Gory

Only a few infestations were found in shade and ornamental white birch in the northwest counties. Borer activity in 1969, combined with a very dry summer, resulted in considerable twig and tree mortality in 1970. Another very dry summer caused birch leaves to fall in August for the second consecutive year in the northwest.

Two-Lined Chestnut Borer - Agrilus bilineatus (Weber)

Severe mortality to merchantable northern pin oak (Quercus ellipsoidalis E. J. Hill) has occurred on an area of approximately 2,000 acres in Menominee County involving parts of Sections 4, 5, 6, 7, 8 and 9, T28N, R16E and Section 33, T29N, R16E. Dying trees exhibited symptoms similar to those of oak wilt, but laboratory cultures indicated that oak wilt was not the cause.

The general area has a history of having been infested by various oak leaf tiers and skeletonizers, but is not known to ~~have been~~ defoliated by walkingsticks which have been active in other parts of the county. Insect galleries and emergence holes in the dead branches indicate the two-lined chestnut borer is involved.

Activity by the borer was not observed in the west central counties as it had been in earlier years (1967 and 1968).

Elm Flea Beetle - Altica carinata (Germar)

This flea beetle was common on elms in many areas of Langlade, Marathon, Menominee, Oneida and Shawano Counties.

Defoliation was severe on widespread groups of trees. It was especially severe on reproduction in openings or along roadside strips. Reported locations in these counties were too numerous for individual designation by legal descriptions.

Similar defoliation was reported from SW¼ SW¼ Section 3, T19N, R12E in Waushara County.

Aspen Leaf Beetle - Chrysomela sp.

Widespread severe defoliation of aspen by a beetle in the genus Chrysomela was recorded in parts of Lincoln and Vilas Counties. Infestations were heaviest in T34N, Ranges 4 and 5E (Lincoln County); and Section 31, T42N, R7E (Vilas County). Skeletonized aspen foliage had a gray color by mid-June when the insect feeding was at its maximum.

Mature larvae were feeding on the lower surfaces of aspen leaves on June 10 in Vilas County.

Red Turpentine Beetle - Dendroctonus valens Le Conte

This insect was observed in association with Ips beetles in 20-year-old red pine plantings in Marathon County. Some of the trees, not infested with Ips and showing signs of chlorosis, were infested at the root collar by adult D. valens when examined on June 10. The affected plantations were near Mosinee (NE¼ NE¼ Section 7, T27N, R7E) in an area that experienced a severe drought from late July through August, 1969.

Pales Weevil - Hylobius pales (Herbst)

Evidence of weevil attack was noted only on the lower portion of the boles of dead young red pine in an Oneida County plantation (Sections 10, 11, T35N, R7E). Infestations were not found in trees with recently dead branches or tops. Affected trees had unidentified cankers associated with the damage, and will require further study.

Recorded damage to Christmas tree plantations was less than that of recent years in west central counties. A strip of untreated white pine was damaged (flagged) in a Jackson County plantation (Section 5, T20N, R3W). The white pine was adjacent to an area from which red pine had been cleared early in 1969. The red pine stumps had been left untreated. A pales weevil population built up on the red pine stumps, and emerging adults fed on the near-by white pine twigs causing severe flagging which became evident in the spring of 1970. Scotch pine in contiguous strips had been treated for control of root collar weevil and was undamaged by the weevils. The stumps of the Scotch pine were very lightly infested. Oviposition was occurring in Jackson County on May 12. This site was cleared of remaining stumps and cull Scotch pine in June of 1970 and seeded with a rye cover crop. It is scheduled for replanting with Scotch pine in 1972 (Figures 1 and 2).

Pales weevil is commonly found in areas infested by root collar weevil in the east central counties.

Severe flagging was noted in a white pine windbreak in Rock County (N½ Section 21, T1N, R10E) on April 29. Examination of fresh stumps near-by, from which white pine Christmas trees had been cut in the fall of 1969, revealed numerous pales weevil adults and even more numerous northern pine weevils (see page 8) laying eggs in the stumps. When the plantation was revisited on May 12 only a single pine weevil was found but pales weevils were very active in the duff and mating was occurring. In this instance, the two weevils were observed in a part of the state where total Christmas tree and other conifer acreage is still very small. Every effort should be made to minimize opportunities for weevil populations to develop to a point where they will be difficult and costly to control.

Pine Root Collar Weevil - Hylobius radicis Buchanan

No new infestations were found in forest plantings in the northwest counties, but the insect was still causing mortality in Scotch pine Christmas tree plantings.

The weevil is present in most untreated plantations of Scotch and jack pines in the west central counties. In this part of the state high mortality occurs in untreated Scotch pine from 5 to 10 years after planting.

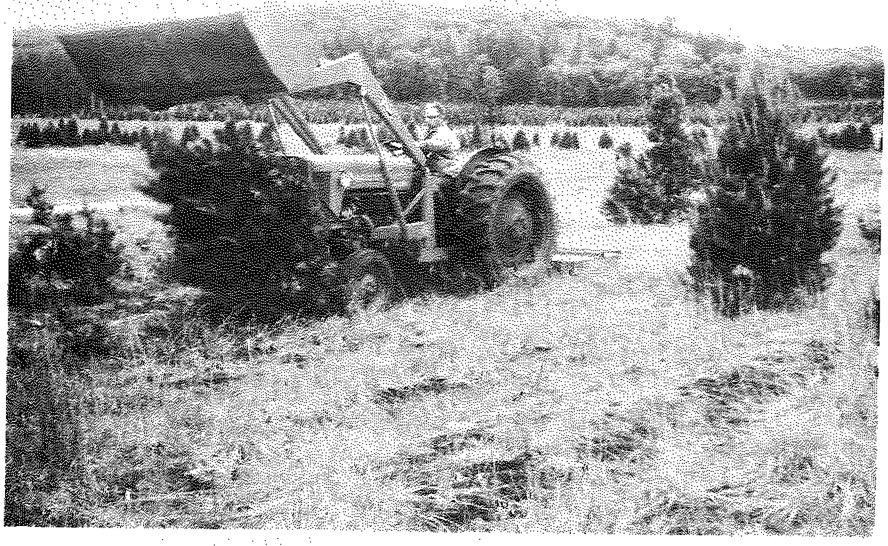


Figure 1. A Jackson County Christmas tree grower attempted to reduce pales weevil threat by knocking down cull trees and shredding them and stumps with a rotary mower.

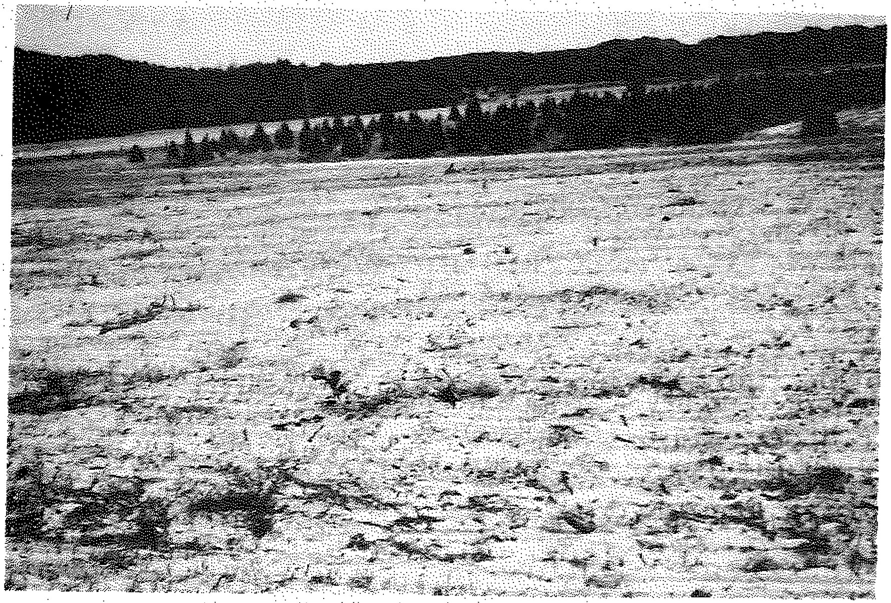


Figure 2. The site was plowed and seeded with rye. Notice dislodged broken remnants of trees drying on ground surface.

It is common in Portage and Waushara Counties and less prevalent in Marquette, Waupaca and Green Lake and other east central counties where Scotch pine is most seriously affected and occasionally red and jack pines are killed. In the counties mentioned, pales weevil is commonly found in the same areas as the root collar weevil.

Pine Root Weevil - Hylobius rhizophagus Millers

As in previous years some flagging and tree mortality was observed in areas of known infestations in Burnett, Polk and Washburn Counties, but no new areas of infestation were reported.

The weevil continued to destroy jack pine plantations in several west central counties. Flagging and mortality were noted in red pine growing adjacent to infested jack pine.

Over a period of several years damage caused by this insect has been declining in east central counties as highly susceptible stands succumbed to attacks and few new infestations started. The favorable change has been particularly noticeable in Waushara County.

Native Elm Bark Beetle - Hylurgopinus rufipes (Eichoff)

The beetle is known to be present in all but three Wisconsin counties. Its presence is suspected but not confirmed in Douglas, Washburn and Vilas Counties.

Dead and dying elms examined during 1970 in the east central counties revealed a higher incidence of smaller European elm bark beetle galleries than those of the native beetle. Galleries of the native beetle appeared to be smaller than in previous years. Evidence of both species of beetles could sometimes be found in the same tree. The native beetle utilized the lower parts of the tree where the bark was thicker. Mostly white ash and some green ash reproduction is abundant in many of the deteriorating elm stands.

Special Note:

Approximately 100 elm logs (Ulmus americana L.) originating from the vicinity of Campbellsport, Wisconsin (Fond du Lac County), were shipped to Laona (Forest County) during the fall of 1969 and April, 1970. Many of the logs exhibited characteristic brown streaking of Dutch elm disease. Logs were examined on May 8, 1970 for the presence of elm bark beetles that might transmit the disease from the logs to elms growing around Laona. No larvae were found in them but samples of adult beetles were collected from several logs. All of the beetles were the native beetle, although a few logs from disease-killed trees had larval galleries characteristic of the smaller European elm bark beetle. The nearest healthy elms to the log decks were approximately 200 yards away. Tanglefoot traps were placed in two strategic locations and examined periodically throughout the summer. They caught only adults of the native beetle.

More details on native elm bark beetle activity may be found in a special report on Dutch elm disease which starts on page 41.

Phenological Note:

May 5 - Adults tunneling and feeding in healthy American elm branches in Marathon County. Elm buds just opening.

June 5 - Flight of overwintering adults reaching peak in Menominee County. First early wilt symptoms observed in infected elms verified infected in 1969.

Pine Bark Beetles - Ips sp.

In spite of the very dry summer, bark beetles did not cause any serious damage in the northwest counties. Only an occasional tree was killed by bark beetle activity and these were widely scattered throughout the pine types.

Bark beetles were active during the year in the northeastern counties. Damage was especially heavy in red and jack pine plantations. Drought conditions during late July and August, 1969 apparently contributed to the loss of trees. Plantings on light soil and on rock outcrops near Mosinee in Marathon County showed signs of infestations in April, and reports of bark beetle activity continued to come in during May and June. Young red pine plantings in Marathon, Oneida and Vilas Counties were particularly affected. A mature jack pine stand in the Conover budworm area, adjacent to a recently clear-cut opening required additional salvage cutting. Noteworthy infestations occurred in Section 10, T42N, R7E, and Section 28, T42N, R10E (Vilas County); SW¼ SE¼ Section 23, T38N, R7E, and SE¼ NW¼ Section 29, T36N, R11E (Oneida County); NE¼ NE¼ Section 7, NE¼ SE¼ Section 16, Sections 15, 17, 21, 28, 29, T27N, R7E; and Section 2, T28N, R6E (Marathon County).

Bark beetle populations were moderate to high during the summer months in the west central counties. Reports of infestations diminished in September following a replenishment of moisture. A few residual trees were killed by bark beetles on three Black River State Forest thinning projects (Jackson County).

Many red pine in a Waupaca County plantation (SW¼ SW¼ Section 30, T21N, R13E) that was severely pruned, were attacked by beetles. The trees were from eight to ten feet tall and two to three inches D.B.H. The beetle population was high in the slash.

Phenological Notes:

May 21 - Adult beetles active in Vilas County in red pine.

June 10 - Adults active, eggs present in galleries in red pine in Marathon County.

July 7 - Adults and larvae active in jack pine in Vilas County.

A Chrysomelid - Metachroma orientalis (Blake)

Beetle specimens collected by Mr. Allen Prey from newly planted red pine seedlings in a seed orchard near Boscobel were identified by Mr. Lutz Bayer of the Department of Entomology, University of Wisconsin. The identification was confirmed by R. E. White of the U. S. National Museum.

The Boscobel collection from Section 10, T8N, R1E (Grant County) may be a new state record. The significance of the beetles' presence in the red pine seed orchard is presently unknown. Adults were feeding on the pine needles on July 22.

Another collection apparently was made on July 12, 1960 in a 40-acre red pine plantation in Adams County.

June Beetles - Phyllophaga spp.

Very few adults were observed and no tree damage was reported in the northwest. A red pine plantation in Washburn County had been severely damaged by larvae in 1969 but the tree mortality was not discovered until this year.

Approximately thirty acres of Eau Claire County Forest plantation (Section 14, T26N, R5W) were damaged by white grubs. Losses ranged between 10% and 20% of the seedlings planted in 1970. Similar damage occurred in a plantation at Camp McCoy in Monroe County. Damage from grubs was neglible in other west central locations.

Much evidence of larval feeding was observed in grassy areas in east central counties during 1969, particularly on lighter soils, but there was little tree damage. This was followed by large flights of adults in 1970 in these areas. Adult beetle populations were very high in the city of Waupaca. The insects, attracted by lights, were a nuisance around some business establishments such as drive-in eating facilities. Most of the beetles were Phyllophaga drakii Kearby.

A captive young fox, tethered under a light in Oshkosh, was observed to eat more than 50 beetles in an hour. The beetles were mostly P. drakii and some Phyllophaga tristis.

Northern Pine Weevil - Pissodes approximatus Hopkins

Several young red pines were attacked by this insect in a plantation in Ashland County (Section 15, T42N, R1W).

Damage from this insect can be found every year in plantings on adverse sites in the east central counties. Scotch pine is most commonly affected. Plantations in coarse sand, or over a gravel subsoil readily affected by drought, are commonly attacked by this weevil. Red pine, from four to seven feet tall, were attacked in a Portage County plantation (W½ SW¼ Section 22, T21N, R10E).

Adult weevils were numerous (estimated 50 per stump), mating and laying eggs in white pine stumps in a Rock County Christmas tree plantation on April 29 in N½ Section 21, T1N, R10E. Most of the stumps were fresh with at least one green branch. Trees from four to seven feet tall had been removed from them in the fall of 1969 in a partial harvest of the plantation. On May 12 a diligent examination of many stumps in the same plantation produced only a single adult beetle of this species. (See reference to pales weevil, page 4).

White Pine Weevil - Pissodes strobi (Peck)

Northwest - Damaged leaders on white pine and other hosts were less prevalent this year indicating a definite decline in populations.

Northeast - Populations were generally light throughout all counties of the area. Occasional infested terminals were observed on white pine, jack pine, Scotch pine and Norway spruce. Plantings of white and jack pine are rapidly outgrowing the problem, but the weevil will continue to be a problem in Christmas tree plantings of Scotch pine and Norway spruce.

West Central - Ten to twenty per cent of the white pine were infested in plantations and open stands in Clark and Jackson Counties, about the same incidence as in 1969.

East Central - After many years of little evident damage by the weevil, the incidence increased in 1969 but did not increase further in 1970. Infested leaders examined in late summer indicated survival of the weevils had been poor. As in several past years severe drought conditions are suspected of being an important factor in weevil mortality particularly since they occurred at the time when larvae were most demanding on the host trees and competitive with one another.

A Scolytid -

Adult beetles were observed in galleries around the root collar area of young red pine in an Oneida County planting, and in mature natural jack pine in Vilas County. Infested trees of both species were also infested with Ips spp.

The Oneida County plantation was in SW¼ SE¼ Section 23, T38N, R7E. The infested jack pine was in Section 28, T42N, R10E, Vilas County.

Adult beetles were active in the young red pine on May 21 in Oneida County and in jack pine in Vilas County on July 21.

DIPTERA

Balsam Gall Midge - Dasineura balsamicola (Lintner)

A moderate infestation persisted for the second year in a natural balsam fir stand in Washburn County (Sections 14 and 15, T38N, R13W). Light infestations were observed in natural stands in northern Waupaca County.

Heavily infested trees were common again in some northeastern counties. The insects were a problem to Christmas tree growers in Langlade County (Section 23, T30N, R7E, and Sections 7 and 17, T31N, R12E), Lincoln County (Section 24, T33N, R7E) and Oneida County (Section 8, T37N, R9E). Most attempts by growers to control the insect by mistblower application of malathion failed.

Phenological Notes:

May 17 - First emergence of adults noted in Langlade County (Section 23, T30N, R12E).

May 18 - Adult midges were numerous in collection traps. Large swarms of adults in lower parts of trees in area where infestation was heavy in 1969 (Section 23, T30N, R12E).

May 25 - Small unidentified wasps were common in trap vials and gall midges were abundant. New shoots on balsam were up to one and one-half inches long. Same legal description as May 17 and 18 entries.

June 10 - Galls were abundant and conspicuous in Langlade County (SE¼ NE¼ Section 17, T31N, R12E).

Red Pine Needle Midge - Thecodiplosis piniresinosae Kearby

Light infestations were scattered in red pines over much of Washburn County, but no heavy infestations were found in the northwest. Infestations were also light in most red pine stands in the west central counties. Minor damage was reported from an Eau Claire County Christmas tree plantation. A severe infestation was noted in a plantation near Lone Rock in Sauk County.

Stable Fly - Stomoxys calcitrans (Linnaeus)

Flies were numerous on Rock Island (Door County) on July 15. Decaying aquatic vegetation, which had been washed up on the beaches, and remains of dead alewife were abundant around the island.

HOMOPTERA

Pine Spittlebug - Aphrophora parallela (Say)

No heavy infestations were found or reported in the northwest counties and spittle masses were conspicuously less numerous than last year. Populations also declined in the east central counties where infestations were also light.

Populations were low in northeast counties after reaching a peak in 1968. Scattered light infestations were reported on Scotch pine plantings in Langlade, Oneida and Shawano Counties.

However, more spittle masses were observed in jack pine stands and Scotch pine Christmas tree plantations in the west central counties than in 1969. One Christmas tree grower sprayed a plantation in Juneau County (Section 25, T17N, R3E) and another in Jackson County (Section 28, T19N, R5W) to reduce adult populations. Two gallons of 57% Malathion emulsifiable concentrate (5 pounds active per gallon) were added to water to make 800 gallons of spray mix which was applied at the rate of one pound per acre with a John Bean mistblower. Pre- and post-treatment population counts indicated the treatment was very effective.

Saratoga Spittlebug - Aphrophora saratogensis (Fitch)

No high populations were found in the northwest.

A small area of severe damage was investigated in a private red pine plantation in Eau Claire County (Section 24, T25N, R6W), but generally populations appeared to be low in the west central counties.

A small infested pocket of trees, not previously reported, was found in E½ SE¼ Section 5, T24N, R12E (Waupaca County).

High populations were recorded on the American Legion and Northern Highland State Forests (Vilas County). Approximately 400 acres of red pine plantings were treated effectively with an ultra low volume application of malathion by airplane at one-half pound per acre on the American Legion State Forest. Industrial foresters treated 196 acres of plantations with malathion at the same rate. Mistblowers were used to treat 68 acres with the same chemical at unverified rates in Vilas and Marinette Counties. Table 1.

Table 1. Red Pine Plantations Treated With Malathion to Suppress Saratoga Spittlebug - 1970

Treated Unit	County	Legal Description	Acres Treated
Northern Highland State Forest	Vilas	Sec. 5 & 8, T41N, R8E	42
		Sec. 11, T42N, R6E	59
		Sec. 16, T42N, R7E	20
American Legion State Forest	Vilas	Sec. 27, T38N, R7E	18
		Sec. 35, T38N, R7E	20
		Sec. 5 & 32, T38 & 39N, R8E	39
		Sec. 31 & 2, T39N, R7E	52
		Sec. 3 & 10, T39N, R8E	73
		Sec. 23 & 28, T39N, R8E	47
		Sec. 32, T39N, R8E	30
County Forest	Vilas	SE¼ SE¼ Sec. 6, T40N, R10E	10
		NE¼ NE¼ Sec. 10, T40N, R10E	20
		SE¼ SE¼ Sec. 19, T40N, R10E	15
County Forest	Marinette	Sec. 24, T35N, R17E	1
		Sec. 8, T35N, R19E	14
		Sec. 13, T35N, R19E	4
		Sec. 22, T36N, R21E	4
Industrial Forest	Lincoln	Sec. 11, T35N, R7E	83
Industrial Forest	Oneida	Sec. 1 & 12, T35N, R5E	100
		Sec. 27, T35N, R5E	13
		Total acres treated	664 acres

Phenological Notes:

June 3 - 80% of eggs hatched. New shoots of red pine up to 3 inches long in Marinette County.

July 7 - Spittle masses mostly small and dehydrated in Vilas County. Nymphs mostly in 5th instar. Adult emergence occurring earlier than usual.

July 10 - Nymphal instars: 10% fourth, 85% fifth, and 5% adults in Oneida County.

July 17 - 90% in the adult stage in Oneida County, about a week earlier than usual. Hot, dry weather prevailed the last two weeks.

White-Pine Aphid - Cinara strobi (Fitch)

High populations were noted on white pine at some locations in Waushara and Door Counties.

White pines on the Nevin Hatchery grounds (Dane County) had unusually high populations of aphids and were blackened by sooty mold.

Eastern Spruce Gall Aphid - Chermes abietis Linnaeus

A white spruce Christmas tree plantation was heavily infested in the N½ Section 21, T1N, R10E. Almost every tree in the two to three-acre planting showed signs of old infestations. New galls were forming on new shoots which were very succulent and 1/2 to 3 inches long on May 12. Infested needles were red at the base and green crawlers were observed in the developing chambers. Overwintering females had many unhatched eggs under them.

Cooley Spruce Gall Aphid - Chermes cooleyi Gillette

There was little evidence of activity of overwintering females on blue spruce in a planting in N½ Section 21, T1N, R10E (Rock County) and very few galls were observed on the young trees which were up to 3 feet tall. The insects were laying eggs on Douglas fir of similar height in an adjoining planting, and a few crawlers were moving out of some of the egg masses. The relationship of the insect to the two tree hosts was explained to the tree grower.

Balsam Twig Aphid - Mindarus abietinus (Koch)

Damage was light on Christmas trees in southeastern Portage County (E½ SE¼ Section 5, T24N, R12E).

Moderate populations caused needle distortion on Christmas trees in some Monroe and Jackson County plantations, but populations declined early in the season and damage in the counties was generally less than in 1969.

Heavy infestations damaged balsam in several Langlade County plantations. One grower treated a twenty-acre planting with a half-pound of malathion in three gallons of water per acre by airplane. The application, which was not recommended by the entomologist, produced poor results. The treated block was in Section 28, T31N, R11E. Infestations were especially heavy in Sections 17 and 29, T31N, R12E, and in a few scattered locations in Shawano County. In some stands damaged shoots were outgrown and there was little evidence of injury by the last week in June.

Pine Bark Aphid - Pineus strobi (Hartig)

Several reports of heavy populations on shade and ornamental white pines were received by the entomologist in the northwest. Apparently control efforts in the Hayward Nursery (Sawyer County) were successful since no infested trees were found there.

Approximately twenty-five-year-old white pine along the north edge of a plantation in the NW¼ Section 36, T11N, R9E along the south side of Columbia County road CS had chlorotic needles and a heavy coating of white produced by a severe bark louse infestation. The branches had been pruned to a height of about 16 feet in recent years. The whitewashed appearance extended from 3 to 6 feet above the ground level to within 5 or 6 feet of the lower branches.

Phenological Note:

May 22 - Crawlers from overwintering females' eggs had moved up to new growth on white pines at Nevin Hatchery (Dane County). One of 20 overwintering females observed had laid 5 eggs. New shoots were up to 5½ inches long and needles up to 1/2 inch long.

Pine Tortoise Scale - Tuomeyella numismaticum (Pettit and McDaniel

Infestations were generally light in all counties. Single trees or small groups of infested jack pines were reported from scattered locations throughout the state.

HYMENOPTERA

Black Carpenter Ant - Camponotus pennsylvanicus (De Geer)

On March 26, 1970, carpenter ants created a problem for a meat packing company and its supplier of wooden pallets. New pallets, made of low grade oak, carried ants into the meat packing establishment where no insects could be tolerated. The pallets had been assembled from lumber cut from frozen logs. The entire manufacturing procedure, at that time of the year, did not permit the wood or its contents to thaw. Packed frozen sawdust, resulting from ant activity in the logs, remained in segments of galleries in boards and was not discernible to workers as the boards were assembled and the finished pallets loaded onto trucks.

When a truckload of pallets was brought into the loading dock area of the meat packing plant, the ants thawed sufficiently to become active and started moving about. The truckload had been fumigated at the plant by a commercial pest exterminator under a plastic tarp for 20 hours. Temperatures outdoors remained near the freezing mark during the fumigation period and the treatment had little observable effect on the insects.

Since only an occasional board on a few pallets showed evidence of being infested, these were culled out to avoid repetition of the costly, ineffective fumigation process. Use of chemicals, as a spray or dip, was ruled out because of the possibility of contaminating meat products. Facilities for chamber fumigation or heat treatment of pallet loads were not available. The most likely point to attack the problem appeared to be at the pallet plant.

A conference was held with the pallet manufacturer. His log and lumber storage yard, plant operation, and outdoor finished pallet storage were examined. The problem was eliminated by closer inspection of materials at each step of the pallet-assembly operation at little or no added cost to him.

Introduced Pine Sawfly - Diprion similis (Hartig)

Spring populations were moderately heavy in most white pine areas of the northwest counties. Fall populations were very high in parts of Polk, Barron and Burnett Counties and many trees were severely defoliated. One small private plantation in Grantsburg (Burnett County) was sprayed with malathion by the owner to protect his trees.

The spring generation caused concern in the west central counties but caused no significant defoliation. Fall feeding resulted in severe defoliation on open-growing white pines in Dunn, Pierce and St. Croix Counties.

Fall feeding resulted in conspicuous defoliation on open-grown white pine in northern Waupaca County (S½ SE¼ Section 22, T25N, R12E, and SE¼ SE¼ Section 6, T23N, R11E). Sparse foliage was also noted in the fall along the southeastern edge of Marathon County and the eastern edge of Portage County where defoliation was most evident on open-grown trees and peripheral trees in white pine stands.

Striped Alder Sawfly - Hemichroa crocea (Fourcroy)

An area of tag alder along the Eau Claire River in Douglas County (Section 25, T44N, R10W) was completely defoliated. The larvae also fed on birch, willow and ash in the vicinity of the outbreak. Various larval instars were feeding in August when defoliation was already noticeable.

Red-Headed Pine Sawfly - Neodiprion lecontei (Fitch)

Although colonies were observed on scattered roadside red and jack pines and ornamentals as in 1969, they were much more prevalent in the northwest counties than they have been for several years. Most defoliation was noted after larvae had completed their feeding.

Scattered light infestations were noted in most northeast counties where defoliation was mostly in red pine plantings. A heavily infested sixty-acre red pine plantation was treated in Menominee County (adjoining parts of Sections 23 & 26, T30N, R16E). Malathion was applied at a rate of one-half pound active ingredient per acre with a back-pack mistblower.

Scattered colonies and feeding sites were observed on jack pine reproduction in Trempealeau and Jackson Counties, but numbers of larvae and colonies appeared to be less than in 1969.

Several colonies were observed on red pine in Marquette County (Section 14, T16N, R9E) in east central Wisconsin where the insect has caused little damage in more than fifteen years.

Red Pine Sawfly - Neodiprion nanulus nanulus Schedl

The insect was not observed or reported in 1970.

Jack Pine Sawfly - Neodiprion pratti banksianae Rohwer

A few scattered colonies were found in jack pine stands in Douglas County (T44N, R11W). The insect was not observed in other parts of the state.

Larch Sawfly - Pristophora erichsonii (Hartig)

Most tamarack stands in the northwest counties showed signs of variable defoliation ranging from light to severe. Only occasional stands were in the moderate to severe class. Twenty-two plots checked in the northwest for the last ten years have shown no tree mortality due to defoliation by the sawfly. Annual growth measurements are being continued on the plots and results are being analyzed.

Variable defoliation also occurred in northeastern counties but was severe in some stands, especially in Langlade County (Section 19, T32N, R11E), Marinette County (Section 13, T34N, R17E) and Oneida County (T36N, R9E).

Defoliation was light to medium in scattered stands in Clark, Jackson and Wood Counties.

LEPIDOPTERA

Pink-Striped Oak Worm - Anisota virginiensis (Drury)

The same area of scrub oak in Douglas County (parts of Sections 15, 16, 21, 22, T43N, R12W) was severely defoliated for the third successive year. More tree mortality was noticeable. However, populations were lower than in 1969 and the area of infestation did not expand appreciably. Gross acreage infested remained between 400 and 500 acres.

Phenological Notes:

June 10 - 18 - Moths active and ovipositing.

June 25 - About 50% of eggs hatched and larvae were feeding.

July 10 - Larvae in 2nd and 3d instars.

July 20 - Larvae in 3d through 5th instars.

August 10 - Feeding completed and all larvae had pupated.

Oak Webworm - Archips fervidanus (Clemens)

Colonies were common throughout the scrub oak type in Burnett and Douglas Counties. Heavy infestations were found in T42N, R14W, Burnett County; and in T43N, R11W, Douglas County.

Oak Skeletonizer - Bucculatrix ainsliella Murtfeldt - ?

Skeletonizing of oaks was widespread over the state. Browning and defoliation of oak were especially severe in Buffalo, Trempealeau and La Crosse Counties, and around Devils Lake in Sauk County. Evidence of defoliation was becoming evident in the hills along the western part of the state by early July.

The identity of the species of the skeletonizer(s) involved is being investigated by University of Wisconsin taxonomists.

Birch Skeletonizer - Buccalatrix canadensisella Chambers

A combination of birch skeletonizer and drought conditions resulted in browning of birch foliage over most of the northeast counties. Most foresters and many landowners reported ballooning larvae and defoliation.

Early browning and defoliation of birch in the west central counties appeared to be due to August drought conditions.

Large Aspen Tortrix - Choristoneura conflictana (Walker)

Severe defoliation of aspen occurred over several townships in western Lincoln County, and parts of Forest, Langlade and Oconto Counties. Thousands of acres were defoliated by the time larval feeding was completed in late July. The map on page 17 is based on aerial surveys of defoliated areas on June 18 (Figure 3). Larvae and pupae of the leaf tier were collected in Langlade County on June 7.

Defoliation was apparent in northern Bayfield and northern Douglas Counties, but was much less than in 1969. Scattered larvae could be found in most stands throughout the northwest counties.

Spruce Budworm - Choristoneura fumiferana (Clemens)

Spruce budworm populations declined in all areas of infestation in Washburn and Sawyer Counties reported in 1969 (T41N, R11W and T42N, R9W). Budworm larvae were still present but defoliation that occurred was very light.

Light to moderate defoliation was observed in a new locality in Washburn County. It was apparent on a gross area of about 600 acres of balsam and white spruce in Sections 11 and 14, T41N, R12W.

Eggs were very scarce in both counties when surveys were made in late summer.

The first extensive infestation of spruce budworm noted in northeastern Wisconsin in recent years was found in Oneida County. Defoliation of spruce and balsam ranged from moderate to heavy on 6,500 acres (Figure 4). The infested

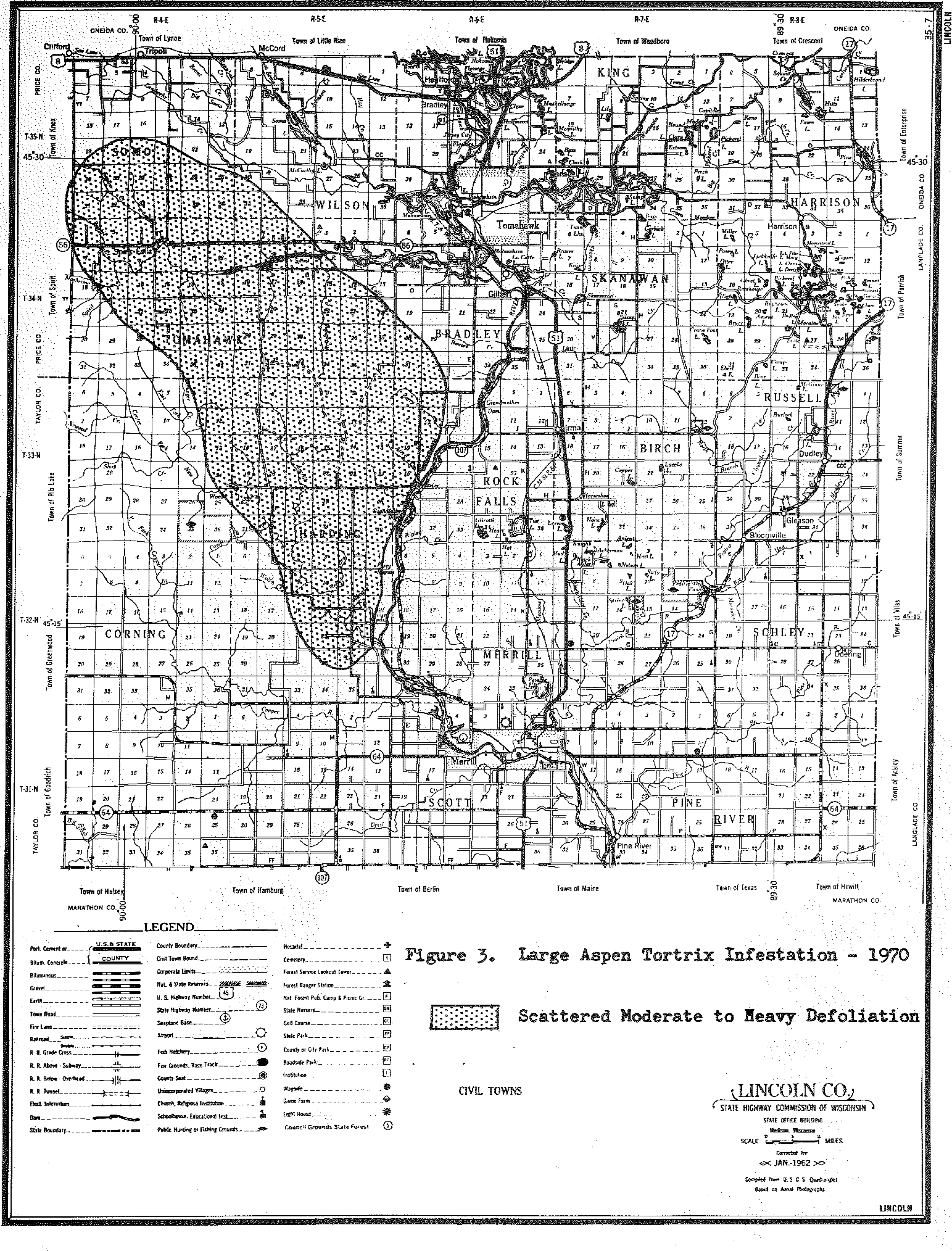

LINCOLN CO.
STATE HIGHWAY COMMISSION OF WISCONSIN
CIVIL TOWNS
LEGEND
SCALE MILES
Corrected for JAN.-1962
Compiled from U.S.G.S. Quadrangles Based on Aerial Photographs
ONEIDA CO.
PRICE CO.
TAYLOR CO.
LANGLADE CO.
MARATHON CO.
SOMO
WILSON
KING
HARRISON
TOMAHAWK
SKANAWAN
BRADLEY
RUSSELL
BIRCH
ROCK FALLS
HARDING
CORNING
MERRILL
SCHLEY
SCOTT
PINE RIVER
Tomahawk
Merrill
Irma
Gleason
Bloomville
Dudley
Harrison
Doering
Pine River
Spirit Falls
Tripoli
Clifford
McCord
Heafford
Bradley
Gilbert
Town of Lynne
Town of Little Rice
Town of Nokomis
Town of Woodboro
Town of Crescent
Town of Enterprise
Town of Parrish
Town of Summit
Town of Vilas
Town of Ackley
Town of Hewitt
Town of Texas
Town of Maine
Town of Berlin
Town of Hamburg
Town of Halsey
Town of Goodrich
Town of Greenwood
Town of Rib Lake
Town of Spirit
Town of Knox
R-4-E
R-5-E
R-6-E
R-7-E
R-8-E
T-35-N
T-34-N
T-33-N
T-32-N
T-31-N
45°30'
45°15'
90°00'
89°30'
LINCOLN
35-7

Figure 3. Large Aspen Tortrix Infestation - 1970

▨ Scattered Moderate to Heavy Defoliation

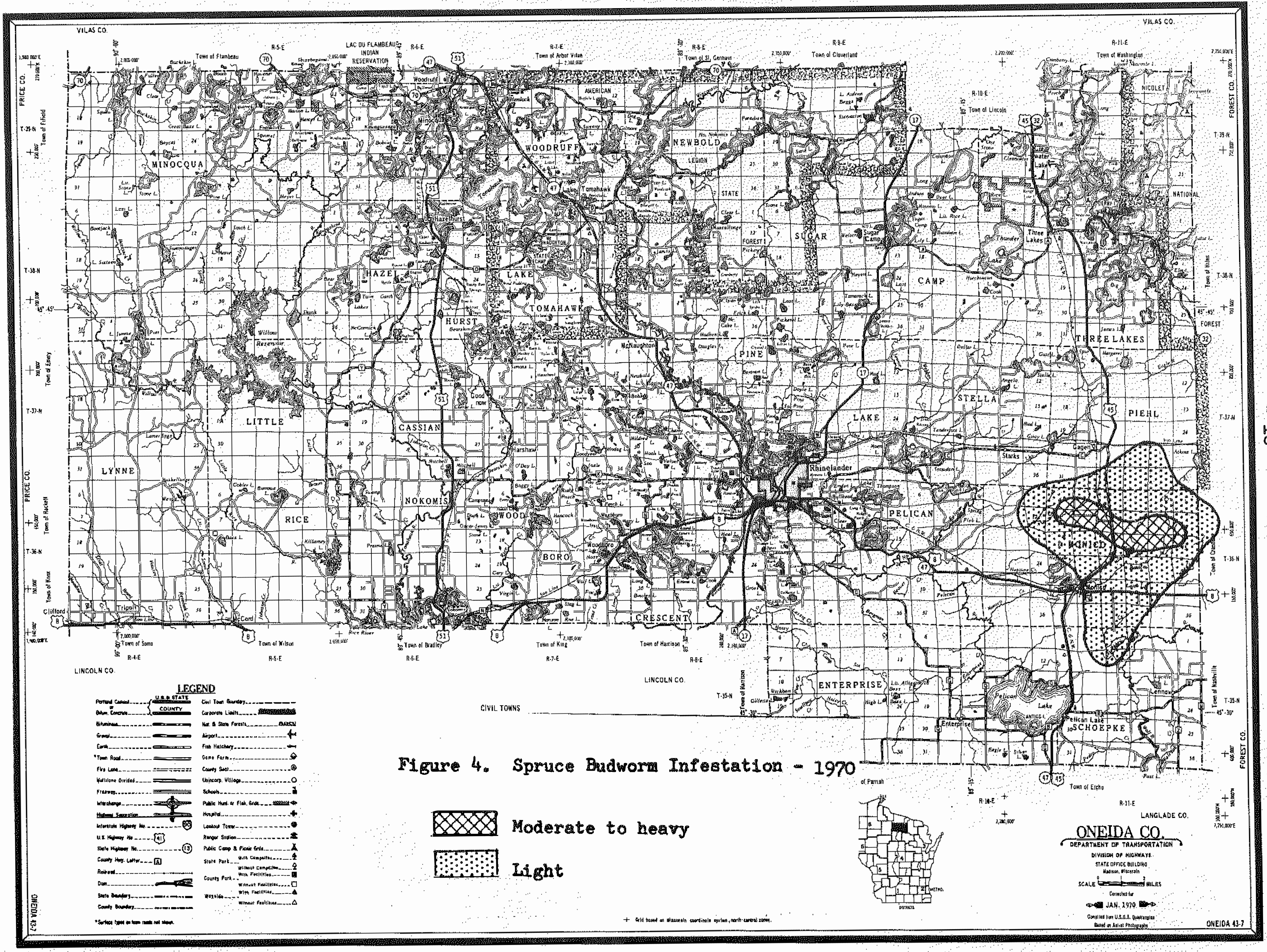

VILAS CO.
PRICE CO.
FOREST CO.
LINCOLN CO.
LANGLADE CO.
LAC DU FLAMBEAU INDIAN RESERVATION
MINOCQUA
WOODRUFF
NEWBOLD
HAZELHURST
LAKE TOMAHAWK
SUGAR CAMP
THREE LAKES
LITTLE RICE
LYNNE
CASSIAN
NOKOMIS
HAZEL
LAKE TOMAHAWK
PINE LAKE
STELLA
PIEHL
CRESCENT
WOODBORO
ENTERPRISE
PELICAN
MONICO
SCHOEPKE
Rhinelander
Pelican Lake
NATIONAL FOREST
LEGEND
ONEIDA CO.
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STATE OFFICE BUILDING
Madison, Wisconsin
Corrected for JAN. 1970
ONEIDA 43-7

Figure 4. Spruce Budworm Infestation - 1970

▨ Moderate to heavy

░ Light

area was part of an industrial forest where spruce had been heavily cut and the balsam left for Christmas tree production.

Apanteles cocoons were abundant in the infestation zone when egg counts were made. The number of egg masses found and their distribution was erratic, but indicate a potential for high populations again in 1971, especially in stands which were moderately defoliated this year.

Phenological Notes:

June 25 - A few late-instar larvae were collected from a Colorado blue spruce in Madison (Dane County).

July 7 - Stages of budworm development in Oneida County were 5th instar larvae - 1%, pupae - 9%, adults - 90% and eggs. Defoliation moderate to heavy.

July 21 - Approximately 50% of the eggs were hatched and larvae were forming hibernaculae in Oneida County.

Jack-Pine Budworm - *Choristoneura pinus* (Freeman)

Northwest - Budworm populations were higher in all northwestern counties except Washburn. Some stands were moderately to severely defoliated in parts of Polk County (T36N, R19, 20W); Burnett County (T40N, R17W); (T41N, R15W) and (T38N, R18W); Douglas County (T44N, R10, 11W) and Bayfield County (T45N, R9W and T46N, R9W). However, little or no top-killing resulted. Pupal and egg parasitism were generally low but the potential exists for a population build-up over a much larger area in the northwest counties in 1971. Egg counts were not consistent with areas of greatest moth abundance and activity. No definite pattern emerged, as it usually does, when egg counts are plotted on maps.

Egg survey procedures will be re-examined to determine if the sampling is providing reliable data.

Northeast - Populations in Marinette, Oneida and Vilas Counties collapsed during the summer. Thirty thousand acres of defoliation, visible from the air, had been mapped in the same counties in 1969. The population collapse was first evident upon completion of the early instar larval counts. Four small potentially troublesome spots remained to be checked during late instar larval surveys. Further indication of the collapse was noted in these four areas as counts were made of 4th and 5th instar larvae and parasitism by *Apanteles* was particularly much in evidence. Population reductions of 65% and 51% occurred within a week in two blocks of timber that had been under consideration for evaluation of aerially applied insecticides.

During the fall of 1969 and spring of 1970, timber sales were established in jack pine stands which had a high priority to be harvested because of previous budworm damage and potential for future damage. Priorities were established on the basis of tree mortality and top-killing that had already occurred, age of the timber, current budworm infestation, and vulnerability to another outbreak. Most damaged and susceptible timber was harvested.

West Central - Budworm populations were reduced to endemic levels in all of the west central counties. Populations in adjoining townships in Adams and Wood Counties, which provided the highest budworm counts in the area in 1969, collapsed without causing apparent defoliation.

Phenological Notes:

May 21 - First active budworm larvae of the season observed in Burnett, southern Douglas and Washburn Counties. Jack pine leaders were 2" to 4" long, pollen flowers yellow-green and hard. A few 2nd instar larvae just out of hibernation were found on jack pine shoots in Oneida County where terminal shoots were about 3/4" long.

May 27 - 2nd instar larvae were out of hibernation in northern Douglas and southwestern Bayfield Counties. Jack pine leaders were 1" to 3" long and staminate flowers were still hard. Budworm and jack pine development were the same in Marinette County.

May 28 - Budworm larvae were feeding in jack pine shoots and flowers along the Burnett - Polk County border. Jack pine pollen was ripe and plentiful. Leaders on jack pine were 3" to 8" long.

June 3 - 4 - Jack pine pollen was ripe and discharging so profusely that it appeared as a yellow-green fog in the air in the vicinity of Gordon (Douglas County).

June 11 - 16 - Larvae were in the 2nd and 3d instars in central Douglas County.

June 17 - Larvae were in the 3d and some 4th instars in Douglas County.

June 18 - Larval development in Marinette County: 2nd instar - 15%, 3d instar - 75%, 4th instar - 10%. Most 4th instar larvae were found where the infestation heaviest and staminate flowers were most abundant.

June 19 - Budworm larvae were starting to pupate in the Town of Sterling in Polk County (T36N, R19, 20W).

June 23 - Most larvae were in the 4th and 5th instars in Douglas County.

June 25 - Larvae were in the 5th and 6th instars in Douglas and Bayfield Counties, and a few pupae were found.

June 29 - Larval development in Murphy Flats area of Marinette County and west Trout Lake area of Vilas County: 3d instar - 5%, 4th instar - 15%, 5th instar - 80%. Approximately 50% of the budworm webs were empty on Murphy Flats and 65% were empty near Trout Lake. Apanteles cocoons were abundant in both locations.

July 1 - About 20% of the larvae pupated in Douglas and Bayfield Counties.

July 2 - Budworm stages in Oneida County: 3d instar - 3%, 4th instar - 7%, 5th and 6th instars - 50%, pupae - 40%.

July 7 - 70% of the larvae had pupated.

July 14 - First budworm moths of the season observed in Douglas County.

Pine Tussock Moth - Dasychira plagiata (Walker)

Once more predicted pine tussock moth populations failed to materialize in T42N, R13W and T43N, R13W in Douglas County. Overwintering mortality combined with parasitism reduced the population so that little noticeable defoliation was evident. However, egg counts were high again in late summer on the same 3,000 acres. Browning of foliage due to fall feeding by larvae was light, but hibernating larvae appeared healthy.

A severe outbreak of tussock moth appeared in Polk County (Sections 3 and 4, T36N, R19W) and adjoining Burnett County (Sections 26, 27, 28, 32, 33 and 34, T37N, R19W). The infestation was reported by a resident in the infested area on June 18. By then larvae were in the 4th and 5th instars and many trees were already completely defoliated. Larvae, migrating in search of food, became a nuisance to some residents in the area. Almost complete tree mortality occurred on about 200 acres of timber. Light to moderate defoliation resulted on an additional 1,800 acres of jack pine. Egg counts made in August were not as high as anticipated based on the numbers of moths that were observed in the area. Late summer feeding caused conspicuous browning of foliage in the treetops in some stands. The potential for serious defoliation in the spring of 1971, especially in stands that were partially defoliated in 1970, existed as the dormant season arrived. Egg counts indicated that the area of infestation had expanded to include parts of Sections 21 and 22 in T37N, R19W, and Section 5, T36N, R19W.

Phenological Notes:

April 23 - First active larvae of the season noted in the Wascott area of Douglas County.

April 27 - Fresh feeding injury on needles first noticeable. Most larvae still in hibernating sites. Douglas County.

May 15 - Larvae feeding very slowly and still 2nd instar in Douglas County.

May 18 - A few 3d instar larvae observed in Douglas County.

June 1 - Larvae mostly in the 3d instar, a few in the 4th in Douglas County.

June 10 - 3d and 4th instar larvae predominant in Douglas County.

June 19 - Larval instars ranged from 4th to 6th in Burnett and Polk Counties.

June 23 - Larvae were in the 4th and 5th instars in Douglas County.

June 24 - Some pupae found in Burnett and Polk Counties.

July 16 - Moths were numerous and some eggs present in Burnett and Polk Counties.

July 20 - All larvae had pupated in Douglas County. A few moths were noted.

July 31 - Eggs were hatching and larvae starting to feed in Burnett and Polk Counties.

August 3 - Eggs were starting to hatch in Douglas County.

August 24 - Recently hatched larvae still feeding in Douglas County.

September 3 - All current year's larvae in hibernation in Douglas County. Very little browning of current year's foliage apparent from pre-hibernation feeding activity.

Walnut Caterpillar - *Datana integerrima* Grote & Robinson

Black walnut, hickory and butternut were severely defoliated in the east central counties where the insects were unusually abundant. Similar defoliation occurred in several locations in the southern counties.

Zimmermann Pine Moth - *Dioryctria zimmermani* (Grote)

The insect was scarce in west central counties. Moderate damage was reported in a few Scotch pine Christmas tree plantations.

Elm Spanworm - *Ennomos subsignarius* (Hubner)

Light defoliation occurred again in northern Bayfield County in T48N, R8W and T49N, R7W. Population levels were lower than in 1969 resulting in less defoliation. Last-instar larvae, pupae, adults and eggs were all present in the area on July 15.

Pine Needle Miner - *Exoteleia pinifoliella* (Chambers)

A moderate infestation of needle miners scattered throughout an area of jack pine in Washburn County (T42N, R13W). Most of the branch tips on infested trees were brown with dead mined needles.

Fall Webworm - *Hyphantria cunea* (Drury)

Webworms were noted over relatively widespread areas in Portage and Waupaca Counties. The principal host tree was cherry. Larvae were in late instars the last week in August.

Aspen Blotch Miner - *Lithocolletis tremuloidiella* (Braun)

Severe infestations were reported in several areas of north central Oneida and south central Vilas Counties. Damage to foliage was severe enough to render ineffective an herbicide application for release of pine from overtopping aspen. Leaves were completely mined and foliage had a mottled yellow appearance by mid-August, especially in Sections 2, 3 and 4, T39N, R8E, and Sections 8 and 9, T39N, R6E.

Empty pupal cases of the miner were abundant on the bottom surface of aspen leaves examined on July 29.

Eastern Tent Caterpillar - *Malacosoma americanum* (Fabricius)

A few tents were located on wild cherry along roadsides and in openings over most of the state. Populations in west central counties seemed to be lower than in recent years.

Forest Tent Caterpillar - *Malacosoma disstria* (Hubner)

No colonies were found or reported on forest lands. No eggs were found during the annual surveys.

Orange-Humped Mapleworm - *Symmerista leucitys* Franclemont

Complete defoliation of maple and other hardwoods occurred on more than 100 acres of timber in Polk County (Section 25, T34N, R17W). The mapleworm was also associated with the variable oak leaf caterpillar in stands defoliated by the latter insect in Jackson and Monroe Counties.

A light population of the mapleworm was active in western Menominee County. Collections in September indicated many healthy larvae were feeding in the understory trees in T29N, R11E and T30N, R13E.

Infestations in Marathon County were in Sections 1 and 4, T26N, R5E. Twenty acres of completely defoliated maple were mapped in Lake DuBay County Park in Marathon County. Collections of larvae in the park showed many of them were flaccid from disease. Larvae were draped over small twigs or hanging limply from the tree trunks by their anal prolegs.

Phenological Note:

September 29 - Most larvae were mature in Menominee and Marathon Counties. Some were pupating.

Bagworm - *Thyridopteryx ephemeraeformis* (Haworth)

Ornamental junipers planted on the DNR Headquarters grounds at Black River Falls (Jackson County) early in the summer of 1970 were found to be infested with bagworms in late summer. The stock, purchased out-of-state, was likely infested when it arrived at the planting site. A single praying mantis was also observed on the trees.

The bagworm larvae apparently did not complete development and pupate before cold weather arrived. They are not expected to be a problem in 1971.

Bagworms were also reported on junipers in Monroe County and at a private campground in Jackson County.

ORTHOPTERA

Post Oak Locust - Dendrotettix quercus (Packard)

Although the insect was commonly observed in 1969 in Marinette County and the west central counties it was not observed or reported anywhere in the state in 1970. No evident defoliation at old infestation sites.

Walkingstick - Diapheromera femorata (Say)

A few walkingsticks were reported from scattered locations in Eau Claire, Jackson and Clark Counties, but no defoliation was apparent.

An area of severe defoliation in the Town of Silver Cliff in Marinette County covered 1,000 acres in 1970. The area of similar defoliation in 1968 covered about 2,500 acres. Even-year infestations have persisted in the same locality for many years with erratic population fluctuations, degrees of defoliation and acreage defoliated.

NEW DEFOLIATOR REPORTED

Variable Oak Leaf Caterpillar - Heterocampa manteo (Doubleday)

This caterpillar identified this year for the first time (in recent years at least) in the west central counties caused spectacular severe defoliation of a 115 acre oak woodlot in Monroe County (T19N, R5W, Section 13, reported August 28, 1970, larvae 1 to 1½ inches).

Other infestations caused scattered areas of defoliation of scrub oak in several sections in eastern Jackson County. A third infestation of undetermined acreage was reported in Dunn County. Overwintering larvae were recovered from one to two inches into the soil on October 22, 1970. (Dunn County, T31N, R12W, Section 3).

The orange-humped mapleworm was also found associated with the variable oak leaf caterpillar in the Jackson and Monroe County areas.

MAJOR FOREST DISEASES

WILTS AND DIEBACKS

Dutch Elm Disease - Ceratocystis ulmi (Buisman) Moreau

Dutch elm disease has been present in Wisconsin since 1956 and is now found in 63 of Wisconsin's 72 counties (Figure 5). Ashland County was the only new county recorded in 1970.

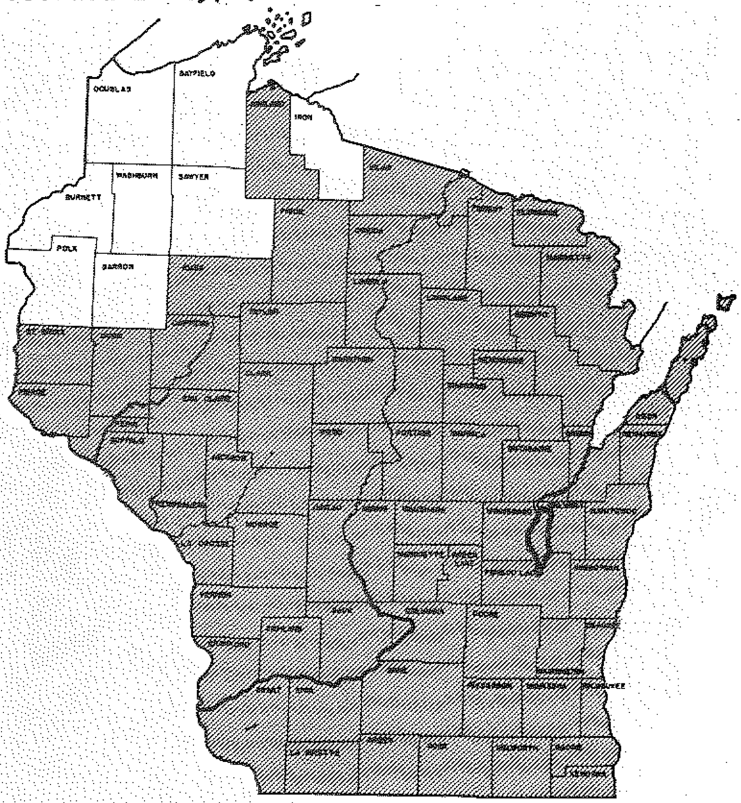
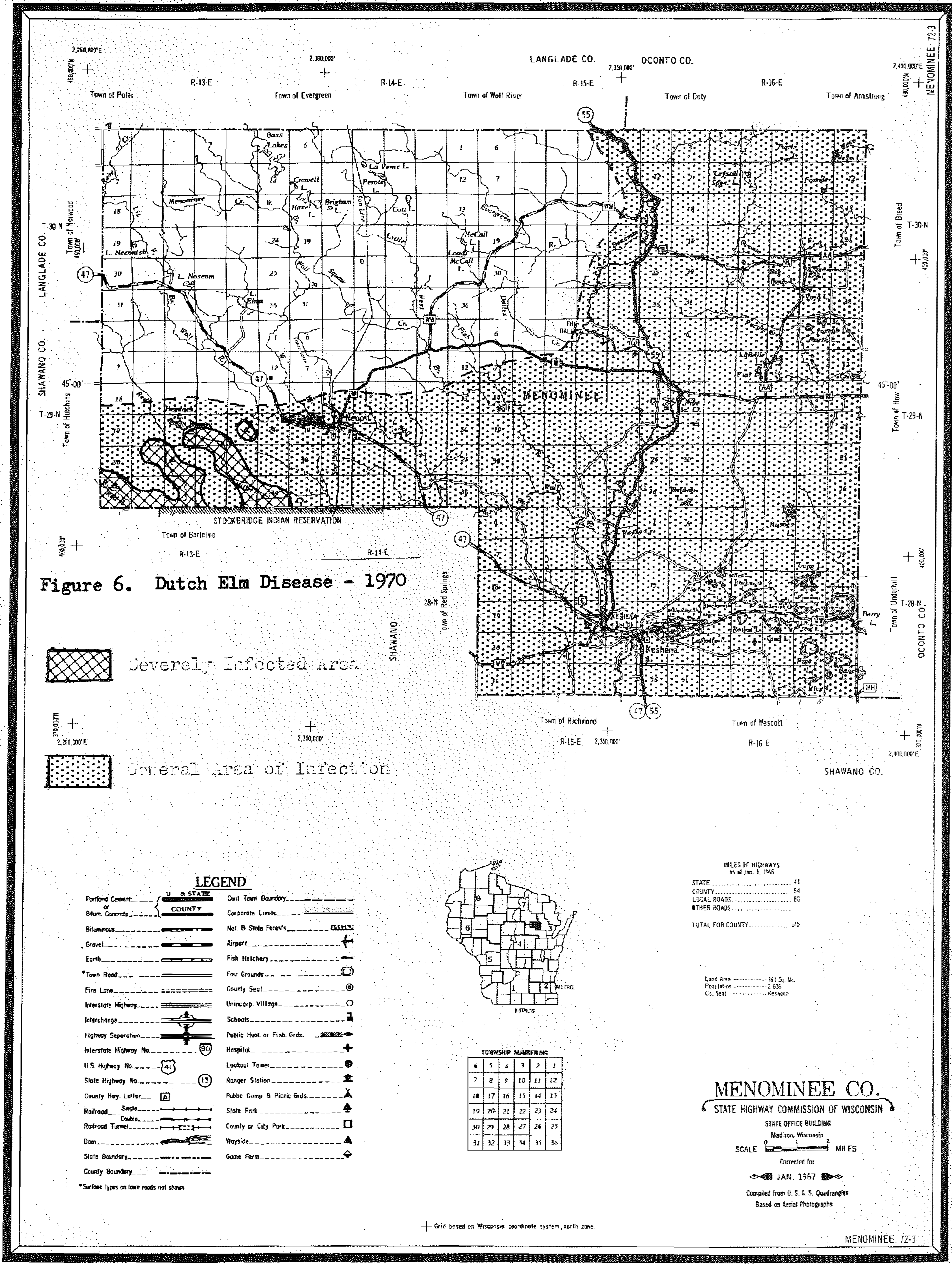


Figure 5. Known distribution of Dutch elm disease in Wisconsin - 1970.

Aerial and ground surveys were continued in Menominee County to record disease incidence and insect vector development. An aerial survey of Dutch elm disease was conducted on July 16, 1970. A Cessna aircraft was flown at 900 feet above the ground which gave optimum ground control and visibility of diseased trees. Flight lines were one mile apart from north to south, starting at the western boundary of the county and continuing to the town of Keshena.

Results of the survey indicated the disease was most prevalent in the southwest corner of the county along streambanks and lowlands which contained a high number of elms. In this area, the disease was occasionally present on high ground away from the streambanks. However, in the northern portion of Menominee County along the Wolf River, the disease did not spread from the streambanks into the northern hardwood types which contained a high percentage of elm.

Most elm in a zone up to a 100 yards wide along the river was dead. The same situation occurred in the southwest corner of the county. Scattered infected trees were found in all townships (Figure 6).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OCONTO CO.
SHAWANO CO.
Town of Polar
Town of Evergreen
Town of Wolf River
Town of Doty
Town of Armstrong
Town of Norwood
Town of Hutchins
Town of Breed
Town of How
Town of Underhill
Town of Red Springs
Town of Bartelme
Town of Richmond
Town of Wescott
R-13-E
R-14-E
R-15-E
R-16-E
T-30-N
T-29-N
T-28-N
45°-00'
MENOMINEE
Neopit
Keshena
STOCKBRIDGE INDIAN RESERVATION
LEGEND
MILES OF HIGHWAYS as of Jan. 1, 1966
STATE 41
COUNTY 54
LOCAL ROADS 80
OTHER ROADS
TOTAL FOR COUNTY 175
Land Area 161 Sq. Mi.
Population 2,606
Co. Seat Keshena
TOWNSHIP NUMBERING
MENOMINEE CO.
STATE HIGHWAY COMMISSION OF WISCONSIN
STATE OFFICE BUILDING
Madison, Wisconsin
SCALE MILES
Corrected for
JAN. 1967
Compiled from U. S. G. S. Quadrangles
Based on Aerial Photographs
Grid based on Wisconsin coordinate system, north zone.
MENOMINEE 72-3

Figure 6. Dutch Elm Disease - 1970

▨ Severely Infected Area

░ General Area of Infection

At Devil's Lake State Park (Sauk County), 52 elms were treated with Bidrin in 1970 and 7 were diseased at the end of the growing season. The treated trees were those remaining from a Bidrin field test initiated in 1967 when 95 trees were treated (Table 2).

Table 2. Bidrin Injection Devil's Lake State Park

Year	Treated Elms (Number)	Treated Elms Diseased (Number)
1967	95	9
1968	86	17
1969	69	17
1970	52	7

$$\frac{\text{Remaining Elms (1970)}}{\text{Original Elms (1967)}} = \frac{45}{95} = 47\% \text{ survival}$$

In 1970 approximately 270 untreated infected elms were marked for removal. A similar number of untreated infected elms were removed in 1969.

Oak Wilt - Ceratocystis fagacearum (Bretz) Hunt

There was no change in the statewide distribution of oak wilt in Wisconsin during 1970. (Figure 7).

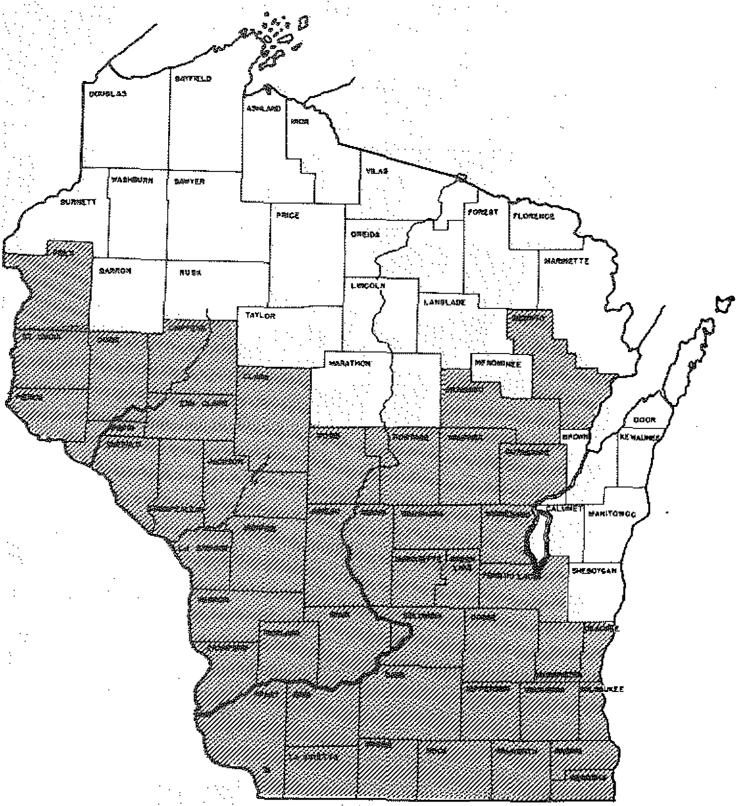
DOUGLAS
BAYFIELD
ASHLAND
IRON
VILAS
BURNETT
WASHBURN
SAWYER
PRICE
ONEIDA
FOREST
FLORENCE
MARINETTE
BARRON
RUSK
LINCOLN
LANGLADE
TAYLOR
MARATHON
MENOMINEE
DOOR
KEWAUNEE
BROWN
CALUMET
MANITOWOC
SHEBOYGAN
MILWAUKEE

Figure 7. Known distribution of oak wilt in Wisconsin - 1970.

The Department of Natural Resources Forest Management Bureau has cooperated with the U. S. Forest Service, Forest Pest Control, State and Private Forestry, St. Paul, Minnesota in an oak wilt survey along the St. Croix River from Hudson to St. Croix Falls.

The Forest Service took aerial photographs of both sides of the river on July 16. The area was photographed with color film, (Ektachrome MS Aerographic film), 9" x 9" format at a scale of 8" = 1 mile (1:7920).

Photos were numbered and examined under an Old Delft scanning stereoscope. A forty acre square section in the center of each photo delineated, using an overlay. Photos without trees in this section were eliminated from the sample. On the remaining photos suspect trees, or groups of trees, within the forty acres were marked. In Wisconsin fifteen photos were selected at random and ground checked for oak wilt. If a tree was not obviously infected with oak wilt, branch samples were collected and isolation made in the laboratory for the disease. The same sampling procedure was used by the Minnesota Department of Agriculture on the Minnesota side of the river.

The results of the survey indicated that about 1 acre of oak in every 40 acres of woodland (2.5%) was killed by oak wilt. A complete report of this survey will be issued by U.S.D.A., Forest Service, Forest Pest Control, State and Private Forestry, St. Paul, Minnesota.

Butternut Dieback - Melanconis juglandis (E. & E.) Graves

Foresters in southwestern Wisconsin reported that dieback and mortality of butternut was a common problem and an examination of some of the areas indicated that the fungus Melanconis juglandis was associated with the dieback. Several areas were sampled in Grant County and exploratory studies were initiated by Professor James E. Kuntz at the University of Wisconsin.

Known areas of butternut dieback in Grant County were mapped by Richard Camp, Department of Natural Resources Area Forester at Lancaster (Figure 8). Mr. Camp also made an aerial survey of the problem areas on July 27 and submitted photographs of representative dieback areas (Figure 9).

ROOT ROTS

Shoestring Root Rot - Armillaria mellea (Vahl ex Fr.) Kummer

Several red pine plantations in Marinette County (NWSW, Section 31, T33N, R19E) were infected with Armillaria mellea following a herbicide release of the northern pin oak overstory in 1966. The complete herbicide kill of the dense oak overstory resulted in many Armillaria infection centers being produced. Approximately 10% of the red pine were killed.

STEM AND BRANCH DISEASES

Eastern Gall Rust - Cronartium quercuum (Berk.) Miyabe ex Shirai

One heavily infected jack pine plantation was reported in Marinette County (Section 28, T34N, R18E) where twenty percent of the trees were infected.

Phenological Note:

May 27 - Sori broken and spores being disseminated.

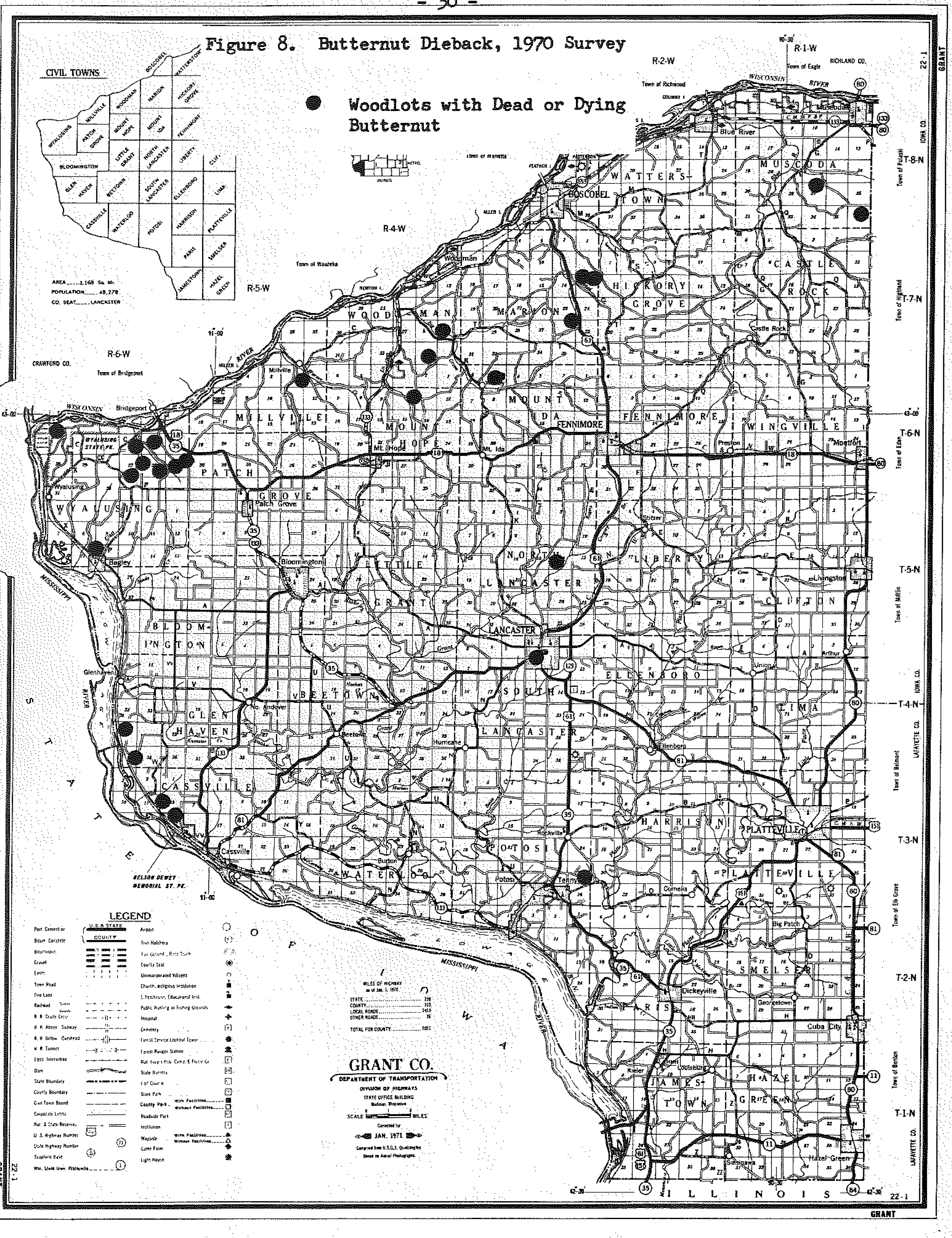

Figure 8. Butternut Dieback, 1970 Survey

● Woodlots with Dead or Dying Butternut

CIVIL TOWNS
AREA 1,168 Sq. mi.
POPULATION 48,270
CO. SEAT LANCASTER
R-1-W
R-2-W
R-4-W
R-5-W
R-6-W
T-8-N
T-7-N
T-6-N
T-5-N
T-4-N
T-3-N
T-2-N
T-1-N
WISCONSIN RIVER
MISSISSIPPI RIVER
WATTERSTOWN
MUSCODA
CASTLE ROCK
HICKORY GROVE
WOODMAN
MARION
MILLVILLE
MOUNT HOPE
MOUNT IDA
FENNIMORE
WINGVILLE
PATCH GROVE
WYALUSING
NORTH LANCASTER
LITTLE GRANT
LIBERTY
CLIFTON
BLOOMINGTON
BEETOWN
SOUTH LANCASTER
ELLENBORO
LIMA
GLEN HAVEN
CASSVILLE
POTOSI
WATERLOO
HARRISON
PLATTEVILLE
SMELSER
PARIS
JAMESTOWN
HAZEL GREEN
BOSCOBEL
LANCASTER
PLATTEVILLE
Blue River
Woodman
Millville
Bridgeport
Mt. Hope
Mt. Ida
Montfort
Preston
Castle Rock
Stitzer
Livingston
Bloomington
Patch Grove
Wyalusing
Bagley
Glenhaven
No. Andover
Beetown
Hurricane
Arthur
Union
Ellenboro
Rockville
Cassville
Burton
Potosi
Tennyson
Cornelia
Big Patch
Dickeyville
Georgetown
Cuba City
Kieler
Louisburg
Sinsinawa
Hazel Green
WYALUSING STATE PK.
NELSON DEWEY MEMORIAL ST. PK.
CRAWFORD CO.
RICHLAND CO.
IOWA CO.
LAFAYETTE CO.
ILLINOIS
IOWA
LEGEND
GRANT CO.
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STATE OFFICE BUILDING
Madison, Wisconsin
SCALE MILES
Corrected to JAN. 1971
Compiled from U.S.G.S. Quadrangles
Based on Aerial Photographs
22-1
GRANT

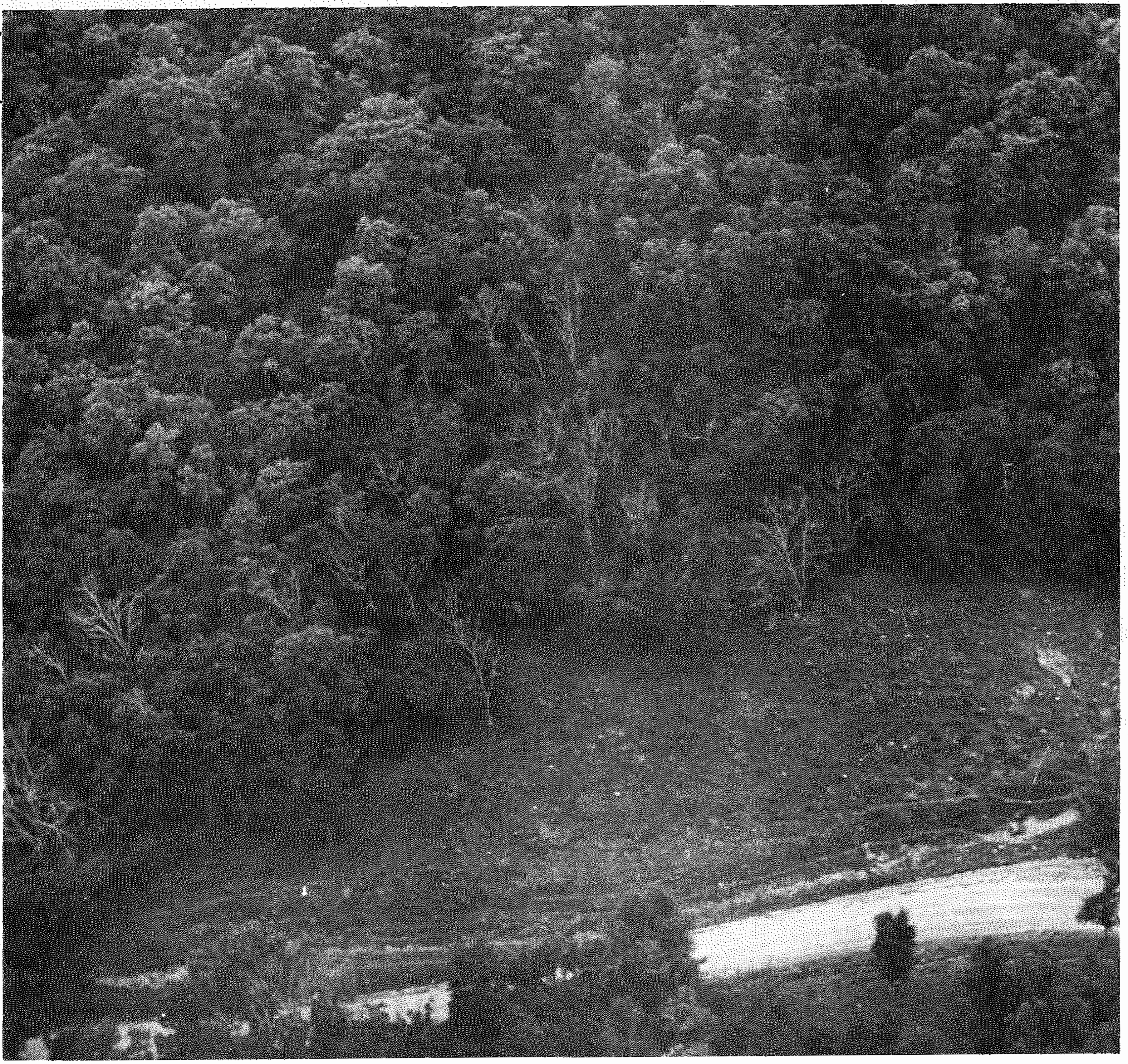

Figure 9. Butternut dieback and mortality in a Grant County woodlot. (Section 1, T6N, R4W). Photographed on July 27, 1970.

FOLIAGE DISEASES

Austrian Pine Needle Blight - Dothistroma pini Hulbray

This disease continues to damage Austrian pine Christmas trees in Wisconsin. Christmas tree producers have given up trying to grow Austrian pine for Christmas trees and many plantations have been harvested or burned. However, some growers did treat their Austrian pine with Bordeaux mixture (8-8-100) at the same time they were treating their Scotch pines for brown spot control. Table 3 lists new reports of Dothistroma pini in 1970 and Table 4 is a tabulation of areas treated in 1970.

Table 3. New Locations of Dothistroma pini on Austrian Pine in Wisconsin, 1970

County	Location	Acres
Pepin	Sec. 31, T23N, R14W	1
Waupaca	W½ SE¼, Sec. 17, T25N, R11E	
Waupaca	S½ SE¼, Sec. 22, T25N, R12E	
Waushara	NENW, Sec. 30, T20N, R12E	5

Table 4. Dothistroma pini Needle Blight Spraying - Wisconsin 1970

County	Location	Treatment Number 1 (acres)	Treatment Number 2 (acres)	Dates	Fungicide	Equipment
Portage	Sec. 31, T21N, R9E	20		May	Bordeaux	Mistblower
			20	July	"	"
Waushara	Sec. 7, T19N, R10E	25		June	"	"
			25	July	"	"
Waushara	Sec. 30, T20N, R12E	12		June	"	"
			12	July	"	"
Waushara	Sec. 36, T20N, R8E	5		June	"	"
			5	July	"	"

Brown Spot Needle Blight - Lecanosticta acicola (Thuem.) Syd.

Brown spot needle blight continued to damage Scotch pine Christmas trees in Wisconsin. Brown spot was first recognized as a problem in Christmas tree plantations when a collection was made in 1966 in Jackson County. Surveys made from 1967 through 1970 indicated the disease was damaging approximately 3,000 acres of Christmas trees in 55 plantations located in 16 counties (Figure 10).

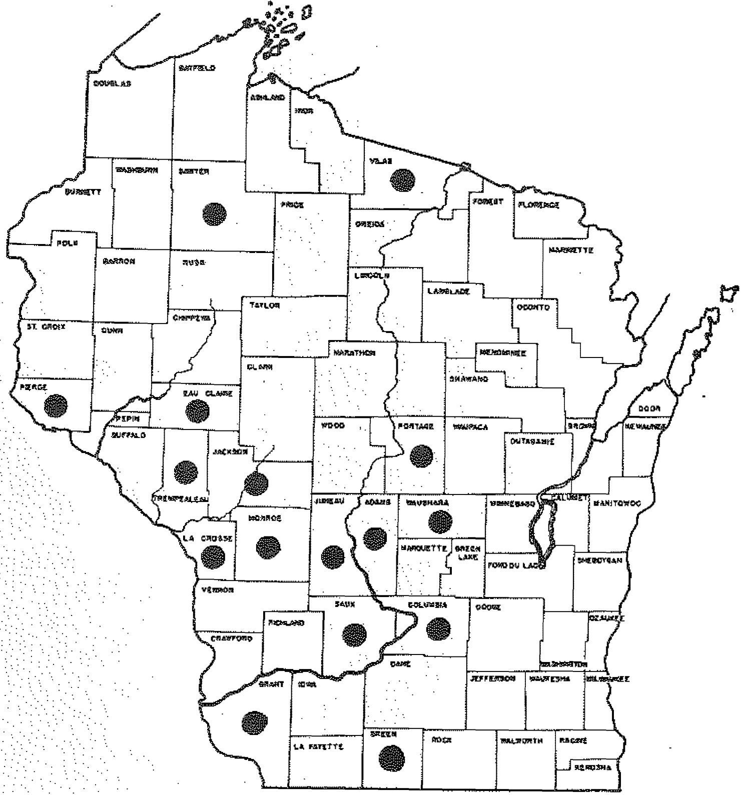
DOUGLAS
BAYFIELD
ASHLAND
IRON
VILAS
WASHBURN
SAWYER
BURNETT
PRICE
FOREST
FLORENCE
ONEIDA
POLK
BARRON
RUSK
MARINETTE
LINCOLN
LANGLADE
TAYLOR
OCONTO
ST. CROIX
DUNN
CHIPPEWA
MARATHON
MENOMINEE
CLARK
SHAWANO
PIERCE
EAU CLAIRE
DOOR
PEPIN
WOOD
PORTAGE
WAUPACA
BROWN
KEWAUNEE
BUFFALO
OUTAGAMIE
JACKSON
TREMPEALEAU
JUNEAU
ADAMS
WAUSHARA
WINNEBAGO
CALUMET
MANITOWOC
MONROE
LA CROSSE
MARQUETTE
GREEN LAKE
FOND DU LAC
SHEBOYGAN
VERNON
SAUK
COLUMBIA
DODGE
OZAUKEE
RICHLAND
CRAWFORD
DANE
WASHINGTON
GRANT
IOWA
JEFFERSON
WAUKESHA
MILWAUKEE
GREEN
ROCK
WALWORTH
RACINE
LA FAYETTE
KENOSHA

Figure 10. Known county distribution of brown spot disease of Scotch pine in Wisconsin - 1970.

Approximately half a million Christmas trees were unmerchantable in 1968 because of brown spot needle blight. Therefore, fungicide testing and brown spot spore trapping was initiated by the Forest Pest Control Section in 1969. Results indicated that three applications of Bordeaux mixture (June, July, August) would effectively control the disease (see 1969 Annual Report of Forest Pest Conditions in Wisconsin). On the basis of these results, several Christmas tree growers engaged in extensive spray programs in 1970 to protect the current year's foliage on French and Spanish varieties of Scotch pine. Approximately 1,000 acres were treated in 1970 using copper-based fungicides (Table 5).

Table 5. Brown Spot Needle Blight Spraying - Wisconsin 1970

County	Location	Treatment Number			Dates	Fungicide	Equipment
		1	2 (acres)	3			
Green	T1N R9E Sec. 1	12			July	Bordeaux	Mistblower
Jackson	T19N R5W Sec. 28	10			6/19	"	"
"	" " "	12			6/17-18	"	Highboy
"	" " "		10		7/16	"	Mistblower
"	" " Sec. 32	10			6/19	"	"
"	" " "		10		7/9	"	"
"	" " Sec. 31	5			7/10	"	"
"	" "	8			6/18	"	"
"	T20N R3W Sec. 7	8			6/4-5	"	"
"	" " "	8			6/4-5	Kocide	"
"	" " "	12			6/20-24	Bordeaux	Highboy
"	" " "	5			6/20-24	Kocide	"
"	" " "				7/2	Bordeaux	Mistblower
"	" " "				7/2	Kocide	"
"	" " "			8	8/10	Bordeaux	
"	T20N R4W Sec. 1	5			6/5	"	Mistblower
"	" " "	4			6/24	"	Highboy
"	" R3W Sec. 9	32			6/24-25	"	Mistblower
"	" " Sec. 4	8			6/16	TBCS 53	Helicopter
"	" " "		8		7/7	"	"
"	" " Sec. 9	15			6/16	"	"
"	" " "		15		7/7	"	"
"	T20N, R1W Sec. 27	10			6/16	"	"
"	" " "		10		7/7	"	"
"	" " "	18			6/16	"	"
"	" " "		18		7/7	"	"
"	T21N R5W Sec. 20	4			6/19-20	Bordeaux	Mistblower
"	" " "	11			6/22	"	"
"	" " Sec. 5 SESE	5				"	Hydraulic Sprayer
"	" " Sec. 5 & 8	5				"	"
"	T22N R5W Sec. 32 SESE	20				"	"
"	" " Sec. 27 NWNE	5				"	"
"	T24N R5W Sec. 32	21			6/6-8	"	Mistblower
"	" " "	2			6/6-8	Kocide	"
"	" " "	16			7/3-6	Bordeaux	Highboy
"	" " "		28		8/14-18	"	Mistblower
"	" " Sec. 25	32			6/9-11	"	"
"	" " "	2			6/9-11	Kocide	"
"	" " "	13			6/25-27	Bordeaux	Highboy
"	" " "		28		8/11-14	"	Mistblower
"	T24N R6W Sec. 22	8			6/11	"	"
"	" " "		8		7/13	"	"

Table 5. (Continued)

County	Location	Treatment Number 1	2 (acres)	3	Dates	Fungicide	Equipment
Jackson	T24N R6W Sec. 30	16			6/12	Bordeaux	Mistblower
"	" " "	69			6/13-15	Kocide	"
"	" " "		28		7/15-16	Bordeaux	"
"	" " "	11			6/13	"	"
Juneau	T16N R4E Sec. 29	18			6/16	Kocide	"
"	" " "		20		7/24-28	"	"
"	" R5E Sec. 29	28			7/29	"	"
"	" " "		28		8/4	"	"
"	" " "				9/19	"	"
"	T17N R3E Sec. 25	20			7/7-10	Bordeaux	"
"	" " "	20			7/7-10	"	"
"	T18N R4E Sec. 33	12			6/15	"	"
Monroe	T19N R3W Sec. 28	62			6/16	TBCS 53	Helicopter
"	" " "		62		7/7/	"	"
"	" R4W Sec. 17	11			6/16	"	"
"	" " "		11		7/7	"	"
"	" " Sec. 26	20			6/16	"	"
"	" " "		20		7/7	"	"
Portage	T20N R7E Sec. 31	160			5/20-6/1	Bordeaux	Highboy
"	" " "		160		6/30-7/7	"	Highboy and Mistblower
"	" " "			160	8/28-9/4	"	Mistblower
"	T21N R10E Sec. 32	86			6/1-3	"	Highboy
"	" " "		86		7/7-8	"	Highboy and Mistblower
"	" " "			86	8/25-28	"	Mistblower
"	" " Sec. 33	75			6/3-4	"	Highboy
"	" " "		75		7/9-10	"	Highboy and Mistblower
"	" R9E Sec. 31	20			May	"	Mistblower
"	" " "	20			July	"	"
"	" " "	6			July	"	"
Trempealeau	T24N R7W Sec. 7 NESE	8	8		6/15	"	Hydraulic Sprayer
"	" " " NESW		8		7/12	"	"
Waushara	T18N R10E Sec. 1	10			May	"	
"	" " "	10			July	"	
"	" R9E Sec. 28	17			June	"	
"	" " "	17			July	"	
"	T19N R11E Sec. 30	12			June	"	
"	" " "	12			July	"	

Table 5. (Continued)

County	Location	Treatment Number			Dates	Fungicide	Equipment
		1	2 (acres)	3			
Waushara	T19N R9E Sec. 6	10			6/9	Bordeaux	Mistblower
"	" " "		55		7/10-14	"	"
"	" R8E Sec. 23 & 26	100			9/8-10	"	"
"	T20N R10E Sec. 3	35			6/4-5	"	Highboy
"	" " "		35		7/9-10	"	Highboy and Mistblower

Excellent control of the disease was obtained in all areas that were treated with Bordeaux mixture (8-8-100) using hydraulic sprayers at 100 gallons per acre or mistblowers at 40 - 50 gallons per acre. Similar applications with Kocide 101 gave fair control of the disease. Evaluation of the effectiveness of two helicopter applications of 3 lbs. of TBCS-53 (Thallophyticidal Basic Copper Sulfate) in 3 gallons of water per acre was difficult because of low disease incidence in the plantations treated.

One custom applicator applied Bordeaux mixture with a roto-mistblower that was formerly used for Dutch elm disease spraying. Good spray coverage was obtained using this mistblower which was so powerful it bent the trees to the ground while spraying.

Previously unreported locations of brown spot in Wisconsin are listed in Table 6.

Table 6. New Locations of Brown Spot Needle Blight in Wisconsin, 1970

County	Location	Remarks
Waushara	NENW Sec. 30, T20N, R12E	Heavy brown spot on 3 Scotch pine trees.
Waushara	S½ NE¼ Sec. 10, T19N, R11E	Evidence of the disease on the south 20 acres.

Lophodermium Needle Cast - Lophodermium pinastri (Schrad.) Chev.

Lophodermium needle cast, which damaged red pine seedlings in previous years at the Hugo Sauer Nursery at Rhinelander, was controlled in 1969 and 1970 by spraying the foliage with the fungicide Maneb. Lophodermium was also isolated from red pine windbreaks in the Hayward State Nursery and preventative sprays of Maneb were applied to the red pine seedbeds. Surveys of windbreaks at the Boscobel and Wisconsin Rapids State Nurseries indicated the windbreaks were relatively free of the fungus and no control measures were needed.

Spruce Needle Cast - Rhizosphaera kalkhoffi Bub.

Rhizosphaera kalkhoffi was reported as causing damage to several Colorado blue spruce Christmas tree plantations in 1970. The disease was severe in Jackson County where more than 20,000 Christmas trees were infected. Phenological data was recorded and periodic collections of foliage taken from infected trees in Jackson County. The information will be utilized in making control recommendations for 1971.

Several Christmas tree growers attempted to control the disease by applying copper based fungicides at the same time they were treating for brown spot needle blight on their Scotch pine (Table 7).

Table 7. Christmas Tree Plantations Treated for Control of Rhizosphaera kalkhoffi on Colorado Blue Spruce, Wisconsin 1970

		Treatment Number (acres)				
County	Location	1	2	Dates	Fungicide	Equipment
Waushara	Sec. 28 T20N R12E	5		June	Bordeaux	Mistblower
"	" " "		5	July	"	"
Jackson	Sec. 7 T20N R3W	4		6/4-5	"	"
"	" " "		4	8/10	"	"
Clark	Sec. 8 T24N R4W	15		6/16	TBCS 53	Helicopter
"	" " "		15	7/7	"	"

Swiss Needle Cast - Adelopus (Phaeocryptopus) gaumanni Rohde

Swiss needle cast or Adelopus needle cast was first observed in Wisconsin on Douglas fir in 1967 in Kewaunee County, NW¼, Section 23, T25N, R25E (see 1968 Annual Report of Forest Pest Conditions page 28). A majority of the infected trees were harvested for Christmas trees in 1970 but the disease is now present on younger trees in the plantation. Adelopus was also observed on Douglas fir Christmas trees in Wood County (Section 23, T20N, R5E).

White Pine Needle Blight - Atmospheric Gases

White pine needle blight which is characterized by a reddish-brown discoloration of the needle tips has been shown to be caused by atmospheric gases such as sulfur dioxide and ozone as reported from scattered areas throughout the state. Most reports were received from Oneida and Vilas Counties.

Needle blight in Vilas County was especially severe and conspicuous when observed on September 3. Many sawlog size white pine on the Northern Highland State Forest were tipburned. This is the first time in the past 10 years that these trees had needle blight symptoms.

Tipburn of white pine was also noted in parts of Ashland, Bayfield, Iron and Sauk Counties. Needle tips were a pinkish-yellow color when observed on August 12 in Iron County. A survey of white pine needle blight was made in a white pine Christmas tree plantation in Green County (Section 1, T1N, R9E) on October 30. A total of 1,188 trees were examined and 118 (10%) were unsaleable as Christmas trees because of needle blight. The Christmas trees were planted about 1,200 to the acre which was close to the number of trees sampled. Christmas tree value of white pine ready for harvest is over $2.50 a tree; therefore, the loss at the plantation was about $300 per acre.

Air Pollution

At the request of the Air Pollution Control Section of the Department of Natural Resources, several areas were examined in 1970 for possible damage to vegetation from air pollutants.

A survey was made near an aluminum smelting plant near Sheboygan Falls in Sheboygan County Wisconsin on June 30. No pollutant injury was noted to mock orange and ninebark growing north of the plant, or on pin oaks planted on the west lawn of the Holden Machine Company. Nor was air pollution damage evident on transplanted hardwood trees in a mobile home park north of the smelting plant. A survey of a northern hardwood-white pine sawlog stand located ½ mile east of the smelting plant did not show any signs of air pollution damage.

A survey was also made in the City of Sheboygan and in the Black Creek Subdivision (south side of town) on June 30 for possible sulfur dioxide damage to vegetation. Reports from this area on September 30, 1969 indicated that air pollution damage was evident at that time on white pine, white birch, pin cherry, lilac and possibly Norway spruce. However, an examination of the same areas on June 30, 1970 did not reveal any damage to current year's vegetation from air pollutants such as sulfur dioxide.

A survey was made on July 28, 1970 in the City of Superior, Wisconsin for possible air pollution damage to vegetation from an oil refinery on Stinson Avenue. No air pollution damage was observed in the southeast area of the city. There was some unknown damage to red pine growing on Wisconsin Point on Lake Superior. Some of the 1969 needles had brown tips or yellow spots. However, the 1970 needles showed no symptoms.

Browning of white pine needles was noted at a wayside stop on the west side of Highway 51 in Section 10, T27N, R7E (Marathon County) on June 30, 1970.

Subsequently, severely damaged white pine was noted in a natural stand near Mosinee (NWNW Section 16, T27N, R7E). This and other stands in the vicinity were examined from the ground on August 3 and September 14 to evaluate damage and condition of trees. An aerial survey was made on August 24 to determine the distribution of white pine exhibiting injury.

The surveys indicated trees were visibly affected in an area that extended approximately 1.5 miles north, 0.5 mile east, 2.0 miles south and 0.5 mile west of a plant which prepared hot-mix blacktop (Figure 11). The plant facility is adjacent to the southwest boundary of the wayside. Current foliage was completely brown on 75% of the trees in the area described. Stands 2 to 5 miles away in a

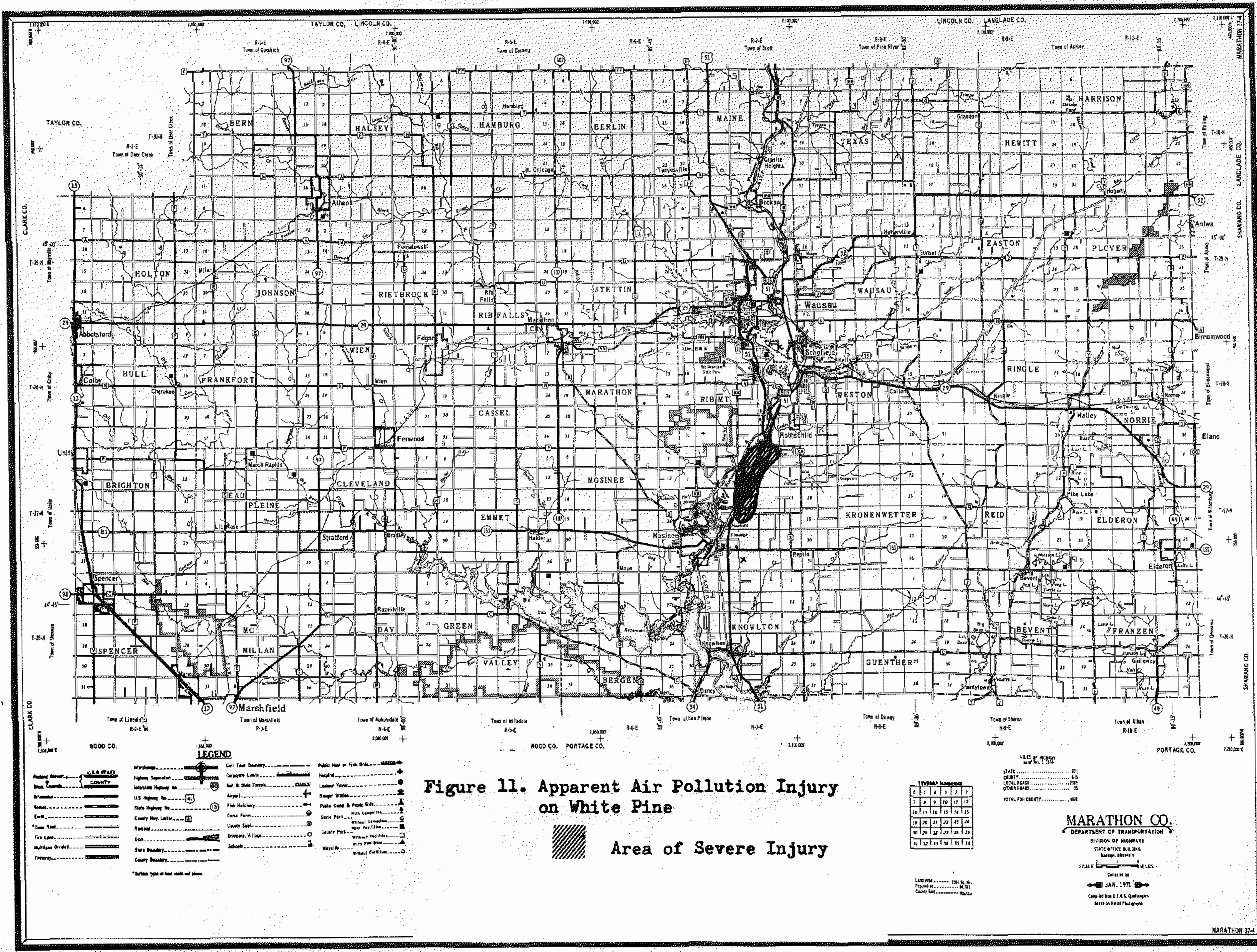
TAYLOR CO.
LINCOLN CO.
LANGLADE CO.
CLARK CO.
SHAWANO CO.
WOOD CO.
PORTAGE CO.
BERN
HALSEY
HAMBURG
BERLIN
MAINE
TEXAS
HARRISON
HEWITT
HOLTON
JOHNSON
RIETBROCK
RIB FALLS
STETTIN
WAUSAU
EASTON
PLOVER
HULL
FRANKFORT
WIEN
MARATHON
RIB MT.
WESTON
RINGLE
NORRIE
CASSEL
BRIGHTON
EAU PLEINE
CLEVELAND
EMMET
MOSINEE
KRONENWETTER
REID
ELDERON
SPENCER
MC MILLAN
DAY
GREEN VALLEY
BERGEN
KNOWLTON
GUENTHER
BEVENT
FRANZEN
Athens
Abbotsford
Colby
Unity
Spencer
Marshfield
Stratford
Edgar
Fenwood
Marathon City
Brokaw
Wausau
Schofield
Rothschild
Mosinee
Knowlton
Dancy
Hatley
Elderon
Birnamwood
Eland
Hamburg
Athens
LEGEND
MARATHON CO.
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
JAN. 1971
MARATHON 37-4

Figure 11. Apparent Air Pollution Injury on White Pine

▨ Area of Severe Injury

northeasterly direction showed no signs of injury. During the September 14 survey, it was noted that tops of some trees were in poor condition. Lower crowns of these trees appeared greener and were not as severely injured.

Suspected cause of the injury was from the discharge of gases from the stack of the hot-mix plant. The discharge apparently occurred during a period when the new needles were highly susceptible to one or more components of the materials being discharged.

OTHER

Aspen Littleleaf

An unusual condition was noticed on many aspen trees in the northern counties. Reports of defoliation were found to be simply small leaves giving the affected tree crowns the appearance of having been defoliated. On some trees the last few leaves formed later in the summer developed to normal size or even larger. The phenomenon is suspected to be an aftermath of the drought period which occurred in the summer of 1969. The condition was prevalent in most aspen stands in Barron, Burnett, Washburn, Douglas and Bayfield Counties. It was observed in other northern counties as far east as Menominee County.

Red Pine Die-Up and Tip Blight - Unknown

An unusual condition known as red pine die-up was observed on the Northern Highland State Forest (N½ Section 24, T41N, R7E) in a plantation about 15 years old. The lower branches of affected trees die prematurely and current year's shoots are sometimes killed.

The malady was called Deerskin Droop because it was first reported several years ago on native red pines growing along the Deerskin River in the Nicolet National Forest in Vilas County.

Lophodermium pinastri needle cast, present in the plantation noted above, did not appear to be associated with the die-up.

Department of Natural Resources and United States Forest Service pest control personnel plan to make a more intensive survey of this malady in 1971.

Winter Injury

Many trees entered the winter with a deficient water supply in stems and needles because of below normal precipitation during the summer and fall of 1969. This resulted in considerable winter burning of conifer needles when dry winds came in March. This damage was more severe in the counties of Barron, Polk, Dunn, Chippewa, Eau Claire, Pierce and St. Croix.

Severe damage to the tops of young Norway spruce and Scotch pine plantings was also reported in Shawano, Langlade, Lincoln and Oneida Counties. Scotch pine exposed above the snow line in late February and March turned bright orange while the Norway spruce turned reddish brown.

DUTCH ELM DISEASE OBSERVATIONS
and
INVESTIGATION IN MENOMINEE AND LANGLADE COUNTIES - 1970

by
Ray Weber
Conservation Technician

OBSERVED SPREAD OF THE DISEASE

The pattern of Dutch elm disease spread and intensification continued during 1970 similar to that reported in 1968 and 1969. Severe infection and mortality of American elm of all sizes continues along waterways and adjacent to low land types in much of Menominee County. This is particularly evident where elm is the most abundant species. Scattered centers of infection are also present along roads and around the edges of fields. These are confined almost entirely to trees less than 18 inches dbh. Considerable spread of the disease also occurred in the farm woodlots of southern Langlade County during 1970. In contrast, very little new infection was noted in the large block of mixed hardwood saw timber in the northwest part of Menominee County. It is anticipated that progress of the disease will be relatively slow in this type as long as there is no logging disturbance. Cutting operations, however, will probably increase the rate of infection. For example, an increase of incipient infection was observed this year, particularly in residual trees of saw log size, where considerable volumes of elm were logged two years ago. One such area is located in the block west of Mill Creek, T29N, R13E.

This apparent buildup after logging is probably due to (1) abundance of beetle brood material created by elm slash, and (2) creation of openings which favor beetle flight from infected material to the crowns of large residual elms.

NATIVE ELM BARK BEETLE INVESTIGATION

Several years of observation indicate that rock elm growing in the same upland type as American elm has a much slower rate of initial infection. This apparent difference might affect the marking decision in logging operations where elm must be salvaged ahead of potential losses from the disease. The difference could be due to several factors, such as:

1. Greater resistance of rock elm to infection
2. Thicker bark, particularly on the lower limbs, which might be a mechanical barrier to transmission of the disease by the elm bark beetle
3. Less attractive to the beetle for feeding purposes

An attempt was made to investigate the last factor by placing 12" x 12" tanglefoot boards on paired American and rock elms at seven locations in Menominee County and three in Langlade County. At all locations, an abundant source of beetle brood material was present, either in the form of dead elm or elm slash. Traps were located on the trunks of healthy trees about five feet above the ground. The paired trees were located in mixed northern hardwood types where both species are common. Traps were examined periodically throughout the summer and the number of native elm bark beetles tallied. For the period May through August, the total number was approximately five times greater from traps placed on American elm. This may be one reason for the lower rate of initial infection in rock elm.

The above data may not be too significant, however, due to the relatively low number of beetles collected in the upland hardwood type as compared to collections in 1968 and 1969 from traps located in stream-bottom elm types. The average per square foot per day on American elm was only one-tenth of that from the lowland elm type. During the three year period of investigation, I have had little trapping success in the upland type even though the brood population was very high in adjacent elm slash. Apparently the beetle is phototropic and tends to fly upward toward the light to feed instead of flying in the relatively dark understory. This might account for the higher incidence of new infections observed in large residual American elms a few years after logging.

CONCLUSIONS AND RECOMMENDATIONS FOR MENOMINEE COUNTY

1. Clear cut all merchantable American elm in stream types and on the upland within approximately five chains of lowland elm types.
2. Delay such heavy marking of rock elm until further observations prove that the species is seriously affected by the disease. In addition to the five-fold preference of the beetle for feeding on American elm, there may also be some mechanical or pathological resistance in rock elm.

Phenological Notes:

May 5 - Adults observed tunneling and feeding in healthy American elm branches. Elm buds just beginning to open.

May 13 - Adults observed feeding and scoring the xylem of healthy young American elms in the vicinity of diseased trees. Elm leaves ¼" in development.

June 5 - Flight of overwintering adult brood reaching a peak. First early wilt symptoms observed on American elms, which were positive cases in 1969.